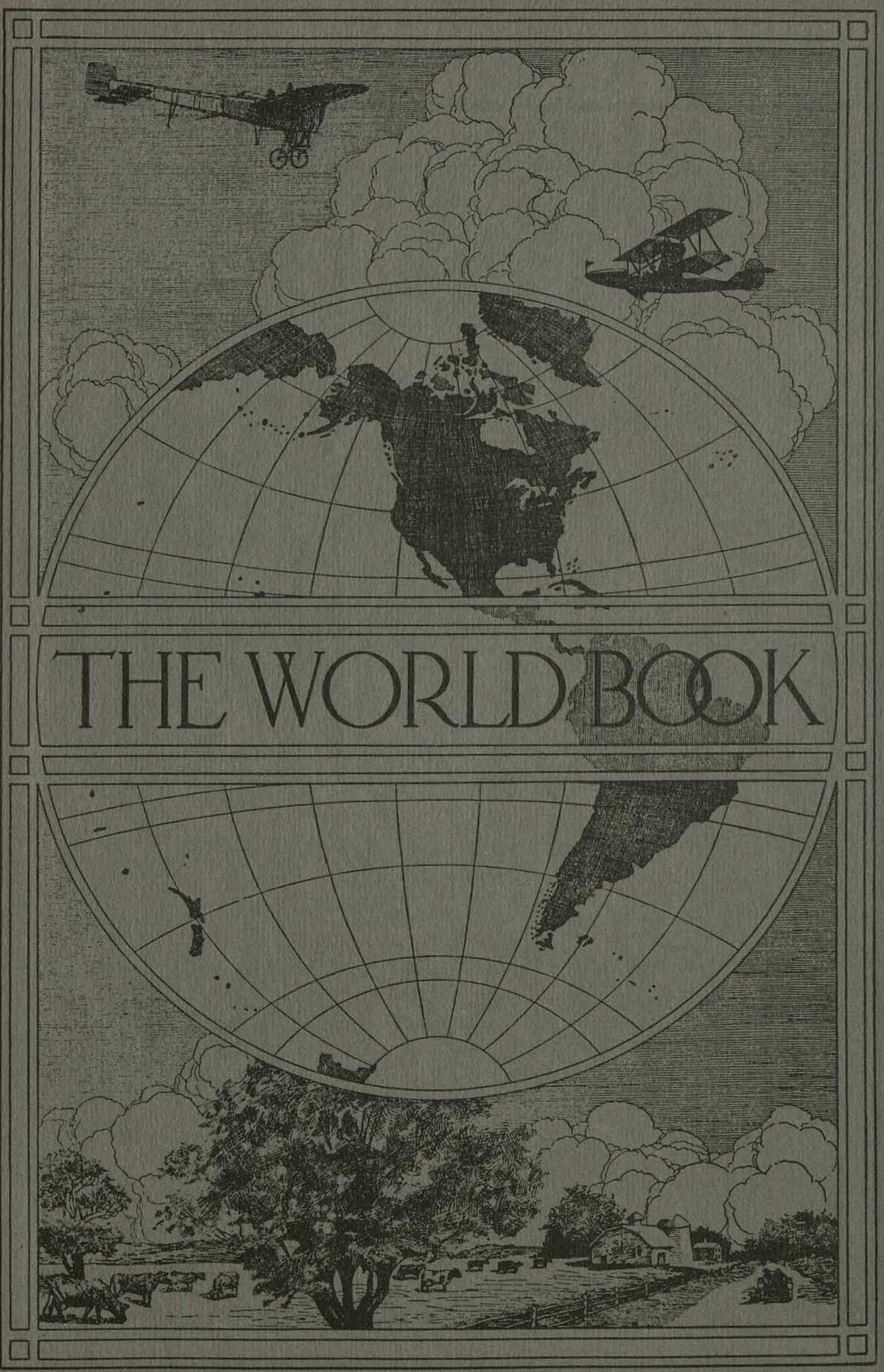
THE WORLD BOOK



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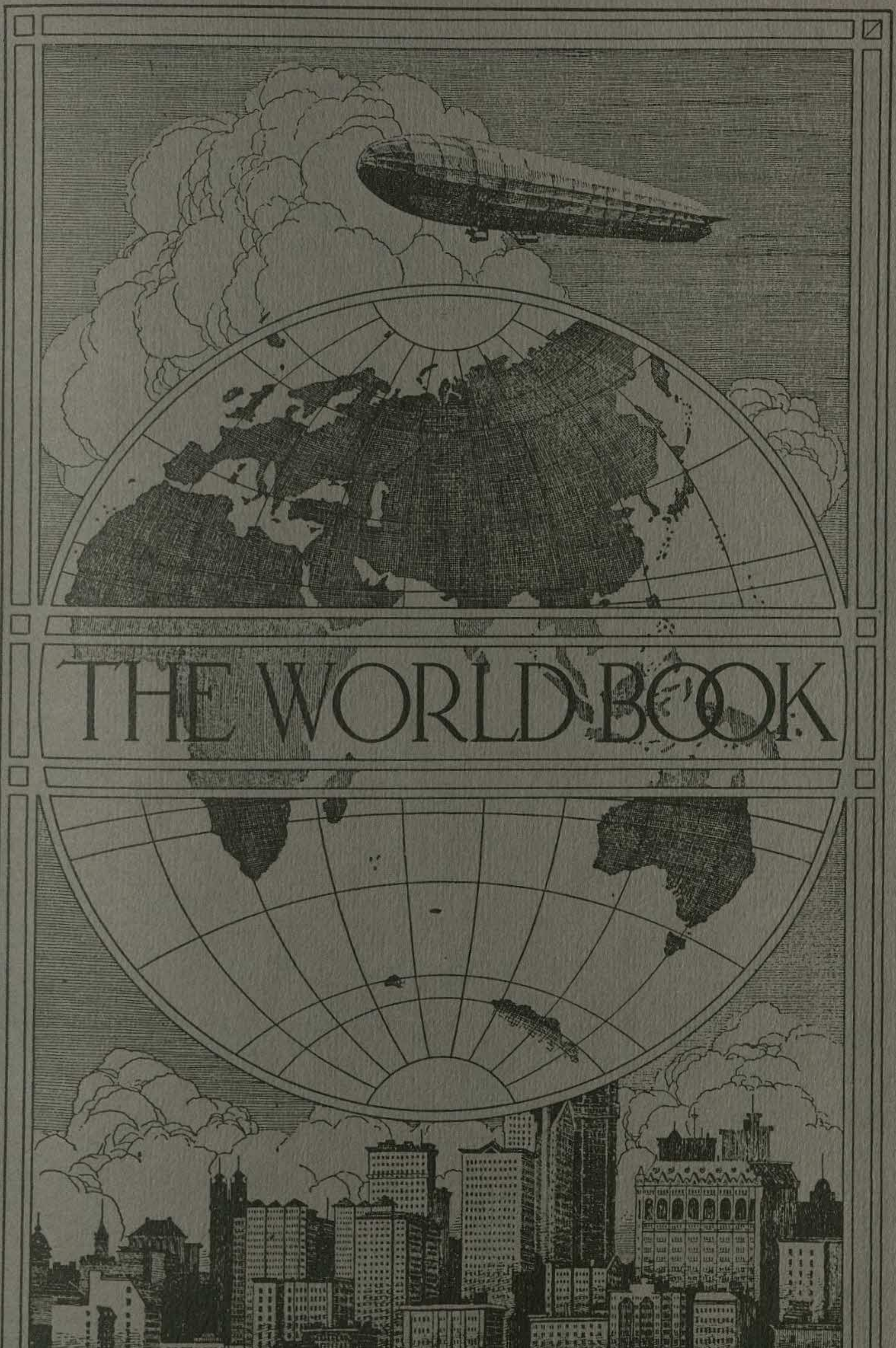
THE WORLD BOOK

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N-O Volume 14

The World Book Encyclopedia

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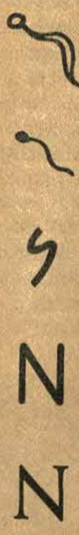
Nn

N is the 14th letter in the English alphabet. It was also the 14th letter in the alphabet used by the Semitic peoples, who once lived in Syria and Palestine. Its symbol apparently came from the Egyptian hieroglyphic (or picture writing) for *snake.* Later Western Semitic traditions called this letter *nun,* which was the word for *fish.* The Greeks took over the letter from the Phoenicians and called it *nu.* See **Alphabet.**

Uses. *N* or *n* is about the fifth most frequently used letter in books, newspapers, and other printed material in English. In mathematics, *n* represents an indefinite number. As an abbreviation, *n* may stand for *noun, neuter, noon, name,* or *not. N,* in chemical formulas, means *nitrogen;* in geographic descriptions, *north* or *northern.* In medieval Roman numerals, *N* represented 90 and $\overline{N}$, 90,000.

Pronunciation. In English, a person pronounces *n* by placing the tip of the tongue against the gums behind the front teeth and making the sound through the nose. In such words as *hymn,* the final *n* is silent. But in such words as *gnostic* or *mnemonic,* the first *n* is pronounced, and the letter before it is silent. Double *n,* in words such as *manner,* is pronounced like *n.* In words like *pen-name,* each *n* is pronounced. The letter has much the same sound in classical Greek and Latin, and in German. In Spanish, when written with a tilde, *ñ,* it has a *ny* sound, as in the English word *canyon.* In French, it gives vowels a nasal sound, as in *pont.*

Development of the letter N



The ancient Egyptians drew this symbol of a snake about 3000 B.C.

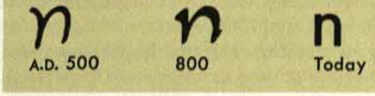
The Semites, about 1500 B.C., wrote the letter in this form.

The Phoenicians simplified the Semitic symbol about 1000 B.C.

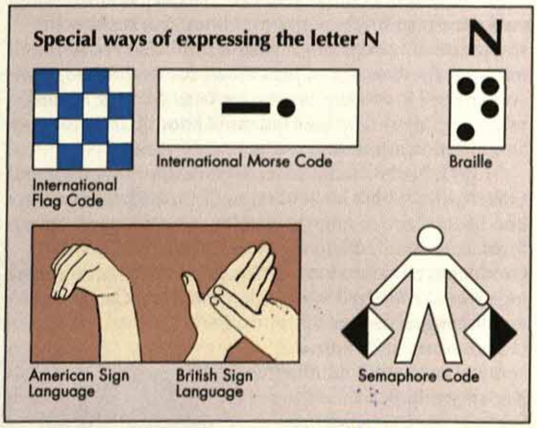
The Greeks changed the letter and added it to their alphabet about 600 B.C. They called it *nu.*

The Romans, about A.D. 114, wrote the letter N with straight lines.

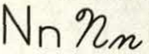
The small letter n developed about A.D. 500 from Roman writing. Monks who copied manuscripts modified the letter during the 800's. By about 1500, the n had its present shape.



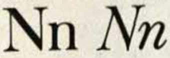
Special ways of expressing the letter N



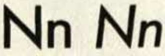
Common forms of the letter N



Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.



Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears on the right.



Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears on the right.

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

Naartoie. See **Tangerine.**

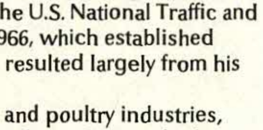
Nabokov, Vladimir (1899-1977), was a Russian-born author. His novels are noted for their complicated plots and the complex attitudes they express toward their subjects. Critics praised Nabokov's novels for their wit, intricate use of words, and rich language. His novels include *Invitation to a Beheading* (published in the Soviet Union, 1938; United States, 1959; United Kingdom, 1960), *The Real Life of Sebastian Knight* (1941), *Lolita* (published in France, 1955; United States, 1958; United Kingdom, 1959), *Pnin* (1957), *Pale Fire* (1962), and *Ada* (1969). Nabokov published collections of stories and poetry and translated several Russian literary classics into English. *Speak, Memory* (1951, expanded 1966) is his autobiography. A collection of Nabokov's lectures at Cornell University in the United States in the 1950's was published under the title *Lectures on Literature* (1980).

Nabokov was born in St. Petersburg. The family fled to Western Europe in 1919 because of the Bolshevik revolution. Nabokov attended Cambridge University in England from 1919 to 1922. From 1922 to 1940, he lived in Berlin and Paris among other Russians who had left their country because of the revolution. He wrote his novels in Russian, and most were later translated into English. In 1940, Nabokov settled in the United States and began to write in English. He returned to Europe to live in 1959.

Nader, Ralph (1934-   ), an American lawyer, became famous for fighting business and government practices that he felt endangered public health and safety. In his book *Unsafe at Any Speed* (1965), Nader argued that the United States car industry emphasized profits and style over safety. The U.S. National Traffic and Motor Vehicle Safety Act of 1966, which established safety standards for new cars, resulted largely from his work.

Nader's studies of the meat and poultry industries, coal mines, and natural gas pipelines also resulted in stricter health and safety laws. He publicized what he felt were the dangers of pesticides, food additives, radiation from TV sets, and excessive use of X rays. Nader said the government was not strict enough in enforcing antipollution and consumer protection laws.

In 1971, Nader founded an organization called Public Citizen, Inc., which he headed until 1980. The organization specialized in energy problems, health care, tax reform, and other consumer issues. Nader and his staff conducted a major study of Congress in 1972. Their findings were published in a book, *Who Runs Congress?,* and in biographies of all U.S. senators and representatives. In 1982, another Nader group published a study of the Reagan administration. Nader was also a coauthor of *The Big Boys: Power and Position in American Business* (1986), which examines the structure of corporate business in the United States.



Ralph Nader

In 1988, Nader's efforts helped bring about the passage of California's Proposition 103, a law that provided for the lowering of some car insurance costs. Nader won another battle in 1989 when General Motors announced it would make air bags standard equipment on many 1990 models. Nader had promoted the use of the safety feature for more than 10 years.

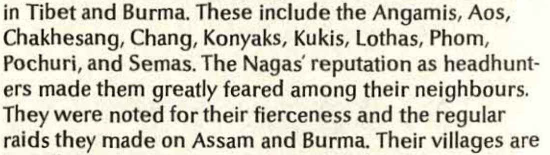
Nader was born in Winsted, Connecticut, U.S.A., the son of Lebanese immigrants. He graduated from Princeton University and Harvard Law School.

Nadi. See **Fiji.**

Nadir is the point in space directly below where one stands. To an observer on earth, the sky appears to be a half-dome whose edge forms a great circle resting on the flat surface of the earth. Imagine a plumb line suspended from the centre of this dome, directly above your head, and passing through the centre of the earth and into space as far as the central point of the invisible half-dome beneath the earth. The two points marking the ends of our imaginary plumb line are, respectively, the *zenith* and the *nadir.* They are the poles of the horizon, and each is 90° from the horizon. See also **Zenith.**

Nagaland is a state in northeastern India. It is a remote and hilly territory, lying to the south of the Brahmaputra River, with Burma to the east. The state is best known for its once warlike tribal population, which took part in the practice of headhunting until the early 1900's.

People and government. The population of Nagaland consists of several groups of tribes that originated in Tibet and Burma. These include the Angamis, Aos, Chakhesang, Chang, Konyaks, Kukis, Lothas, Phom, Pochuri, and Semas. The Nagas' reputation as headhunters made them greatly feared among their neighbours. They were noted for their fierceness and the regular raids they made on Assam and Burma. Their villages are on hilltops and ridges and are still protected by stone walls. The main building in a village is the *morung,* a long house which may be as much as 20 metres long and 10 metres high. Its roof is supported by a single crossbeam. The morung was once the most important house in the community. It was a boys' dormitory and an armoury for storing weapons and displaying the prizes of war. These took the form of enemy heads, often as many as 150 in a morung. When fire destroyed the timber-and-thatch long houses and the skulls inside, the



Nagaland is a small, remote Indian state lying in a hilly area on the Burmese border.

Nagas carved small replica skulls as substitutes. By each morung stood a huge, sacred drum, which the Nagas hollowed out of a tree trunk and carved to resemble a buffalo head. The history of their culture and practices is shown in wooden images, masks, jewellery, and headgear. In some villages, women had the female equivalent of a morung. Women still take an equal share in the work and government of Nagaland today. More than 90 per cent of the population are Christians. The rest are Muslims or Hindus. The main languages spoken are Nagamese and English.

Nagaland has one elected member in the *Lok Sabha* (lower house) and one representative in the *Rajya Sabha* (upper house) of the Indian national parliament. The state legislature has 60 members.

Economy. Some Nagas still practise the "slash-and-burn" techniques of *jhum,* or *shifting cultivation,* where there is room. After cultivating a patch of land for two years, the Naga farmers used to leave it to regenerate by lying fallow for 10 to 15 years. Now, the period between successive cultivations has diminished to a couple of years, and the land is less fertile and productive than it was. The main crops are rice and maize. Millet, oil seeds, potatoes, pulses, and sugar cane are also grown.

The Nagas are today dependent on the timber industry. Nagaland produces a number of woods for export, including mahogany. It also produces fuelwood and many other forest products. Cutting down the large trees, however, has led to soil erosion. Orchard plantations and terraced cultivation are generally being introduced into the state's economy. Bamboo is a valuable and major product.

In spite of the very great importance of timber as a product, there are still many artistic and functional items produced by traditional handicrafts. Women in Nagaland practise the ancient craft of weaving on portable hand looms. They stitch together strips of colourful cloth to produce shawls in different patterns which distinguish each tribe. The shawl is a universal garment worn by Nagas all over the state.

Transport routes are very limited in Nagaland. Roads connect Kohima with Assam and with Imphal, the capital of Manipur to the south, but there are virtually no railways. Dimapur has the only railway station in Nagaland, and an airport that links the state with the rest of India.

Land. Nagaland is bordered on its south, west, and north by the Indian states of Manipur, Assam, and Arunachal Pradesh. It shares an international border with Burma to its east.

Parallel ranges of mountains run from north to south. They have some of the richest forest cover left in India. Evergreen forests are most common below 1,200 metres. Mahogany and bamboo are among the most valuable species. Oak and pine and other conifers are the main types of tree found above 1,200 metres.

Nagaland has many kinds of monkey, including the flying lemur, the long-tailed langur, and the pink-faced monkey. Elephants, porcupines, rhinoceroses, scaly ant eaters, tigers, and wild oxen are common. There are many colourful jungle birds.

Nagaland has a pleasant, temperate climate. But it has very heavy rainfall in the summer *monsoon* months (see **Monsoon**). Winter temperatures range from an average minimum of 8 °C to an average maximum of 15 °C in January. These rise to an average maximum of 25 °C in May and again in August, with average minimum temperatures through the summer of about 19 °C. The whole area has relatively dry winters, receiving less than 10 centimetres of rain between December and March. However, rainfall in the summer is very heavy, giving an annual total of over 180 centimetres in Kohima.

D. Banerjee, D.P.A./Images of India

Nagaland's people are called Nagas. Naga women take an equal share in work and government.

History. The various tribes and tribal groups making up the people of Nagaland came from various regions including Burma and Tibet. They settled in the remote hill country of Nagaland long ago, but experts do not know precisely when. The Nagas have rich and colourful collections of poetry, folk songs, and tales that preserve many ancient legends. This folklore has been passed down from generation to generation. But there is no written account of the early history of Nagaland.

The earliest written references to the Nagas date from the 1200's. At this time, a people called the Ahoms settled in Assam and came into contact with the Naga tribes. According to Ahom chronicles, there were occasional conflicts, but Ahom and Naga chiefs generally had friendly relations. However, raids by one Naga village against another were a feature of life in the hilly areas, and the Nagas decorated their morungs with the skulls of enemies slain in battle.

Until the 1800's, the Nagas led a fairly isolated existence, untouched by the great historical development that affected most other parts of the Indian subcontinent. Then, in 1819, the Burmese invaded Assam and occupied it for seven years. In 1826, the British extended their rule to Assam. They sent out the first of several expeditions to the northeast region in 1832. Although fiercely resisted by the Nagas, the British eventually annexed the area, known as Naga Hills, in 1881.

Facts in brief about Nagaland

Population: *1991 census*—1,215,573.
Area: 16,579 km².
Capital city: Kohima.
Largest cities: Kohima, Mokokchung, Wokha.
Chief products: *Agriculture*—pulses, rice, sugar cane, vegetables. *Manufacturing*—textiles.

The British occupation brought about many deep-rooted changes in the life of the Naga peoples. The British administrators put a stop to headhunting and raids between villages. They also encouraged Christian missionaries to enter the region. The missionaries successfully converted most Nagas to Christianity and set up educational centres.

With education came the growth of political awareness among the Nagas. Many Nagas sought political independence for their highland territory. In 1946, the people formed the Naga National Council with the aim of uniting the whole region in its fight for political rights. In 1947, some sections of the Naga people demanded full political sovereignty as a state separate from India. The government of a newly independent India refused to accept such a demand, and some Nagas took to armed rebellion in an effort to gain independence. The area remained in a rebellious political condition for much of the 1950's.

Eventually, negotiations between the Indian government and the Nagas led to the integration of the region into the Indian republic. Nagaland became a full state of the Indian Union in 1963. Some rebel forces continued to press for full independence, carrying out guerrilla warfare and bandit raids. But their political influence gradually declined.

Since the 1960's, the central Indian government has provided Nagaland with essential aid, and the state has quickly developed commercially. A nationalist party, the Naga National Organization, won power in Nagaland just after it became a state in 1963. But its influence soon gave way to that of the Congress Party.

In March 1992, the governor of Nagaland suspended the state assembly. In April, the Indian government imposed president's rule. In 1993 and 1994, ethnic strife surfaced again in the hills of Manipur as Nagas wanting independence clashed with Kukis, who have been living in the region since the 1700's. The clashes left hundreds massacred and many villages destroyed.

Nagasaki (pop. 444,599) is the Japanese city with which Westerners have had the longest contact. Its harbour was opened to foreign trade in 1571. After 1637, it was the only Japanese port where Westerners were allowed to trade. Dutch traders were permitted to set up a trading post on an island in the harbour, and one Dutch ship each year was allowed to call at the post. In 1857, it was one of the six Japanese ports that were opened to foreign trade.

Nagasaki is on the west coast of the island of Kyushu. It is important as the Japanese port city closest to the mainland of China. Nearby coal fields provide a source of soft coal for export. Nagasaki is on a landlocked bay, which is deep and large enough to hold many ships. For location, see **Japan** (political map).

Because Nagasaki has a large steel rolling mill, it is an important shipbuilding centre. Many of its factories were destroyed on Aug. 9, 1945 during World War II, by the second atomic bomb used in warfare. The blast destroyed 4.7 square kilometres in the heart of the city. It injured 40,000 people, and 40,000 were killed or missing. Since the war, most of Nagasaki has been rebuilt.

Nagoya (pop. 2,154,793) is one of the largest cities in Japan. It is the capital of Aichi prefecture on the island of Honshu. It stands on Nobi plain, facing Ise Bay (see **Japan** [political map]).

Nagoya was once the seat of the powerful *daimyo* (baron) of Owari, a province of early Japan. In 1610, a great five-storey castle was built in Nagoya by the powerful feudal lord Ieyasu Tokugawa. The castle was destroyed during World War II (1939-1945), but was rebuilt in 1959.

Nagoya is famous as a manufacturing centre. It has an important textile industry. It also manufactures machines, pottery, porcelain, lacquerware, clocks, fans, and embroidery. Nagoya's industries and its population are crowded into a closely packed area.

Nagpur (pop. 1,215,425) is an Indian city in the state of Maharashtra. It alternates with Bombay as the seat of

The orange market in Nagpur is the major centre for the sale of oranges from all over India. Visitors and would-be customers can view and inspect the oranges, which lie in neat piles on straw.

the state legislature. The city is situated on the Nag River. For location, see **India** (political map).

Nagpur lies at the junction of major routes linking India's greatest cities (Bombay to Calcutta, and Madras to Delhi). As a result, many of its industries produce transportation equipment. The city also makes a variety of other metal products. Local deposits yield manganese and coal. The region around Nagpur is an orange-growing area.

The city was founded in the early 1700's. In 1861, the British established Nagpur as the capital of the Central Provinces. The city developed as a commercial and industrial centre after the completion of the Great India Peninsula Railway in 1867. The improved transport facilities led to the introduction of a cotton crop and a textile mill to the region.

See also **Maharashtra.**

Náhuatl. See **Aztec** (Language).

Nahum, Book of, is a book of the Hebrew Bible, or Old Testament, named after an Israelite prophet. Nahum lived in the kingdom of Judah during the second half of the 600's B.C. The book has three chapters. Chapter 1, a hymn, is a vision of God that may be the work of another author. In chapters 2 and 3, Nahum praises the capture and destruction in 612 B.C. of Nineveh, the capital of the hated and feared Assyrian empire. His description of the city is so vivid that some people believe he actually lived to witness Nineveh's fall.

The poetic style of the Book of Nahum is among the most elegant in the Bible. Nahum's striking images of God's wrath along with his images of God's refuge and safety lend great power and immediacy to the prophet's words.

See also **Bible** (The Old Testament).

Nahyan, Zayed bin Sultan al- (1916-), became president of the United Arab Emirates (UAE) in 1971. He was raised as a member of a group of *nomadic* (wandering) desert Arabs. He served his political apprenticeship as governor of Abu Dhabi's eastern province from 1946 until he deposed his brother Sheikh Shakhbut bin Sultan, to become *amir* (commander) in 1966. His major achievements included the integration of the seven formerly weak and undeveloped Trucial States into the much stronger federated United Arab Emirates. He unified their defence forces and used their oil revenues to raise living standards at home. He also helped other countries through foreign aid.

Naiad. See **Nymph** (In mythology).

Naidu, Sarojini (1879-1949), was a leader of the Indian women's movement. She became known as the "Nightingale of India," because of her poetry and her speeches. Naidu played an important part in India's struggle for freedom from British rule.

Naidu was born in Hyderabad. Her parents were reformist Hindus from Bengal. She grew up speaking Urdu, Bengali, and English. Throughout her life, Naidu worked to unite the people of many different religions, languages, and communities in India.

Naidu wrote poetry in English. Her three important collections published in the United Kingdom were *Golden Threshold* (1905), *Bird of Time* (1912), and *Broken Wing* (1917). Her best poems, such as "Bangle-Sellers" and "Palanquin-Bearers" catch the colours and sounds of Indian village life.

In 1925, she became president of the Indian National Congress. Like several other leaders seeking Indian independence she was imprisoned several times by the British for her political activities. After India gained independence in 1947, Naidu became governor of the state of Uttar Pradesh.

Nail is a tough plate that covers the upper surface at the end of each finger and toe. It is a special growth of the *epidermis* (outer portion of the skin) and is made up of hardened cells. The skin below the nail, from which it grows, is called the *matrix.* Near the root of the nail, where growth begins, the blood flow in the cells is less visible. The white, crescent-shaped spot indicating this area is the *lunula.* The state of a person's health is often indicated by the nails.

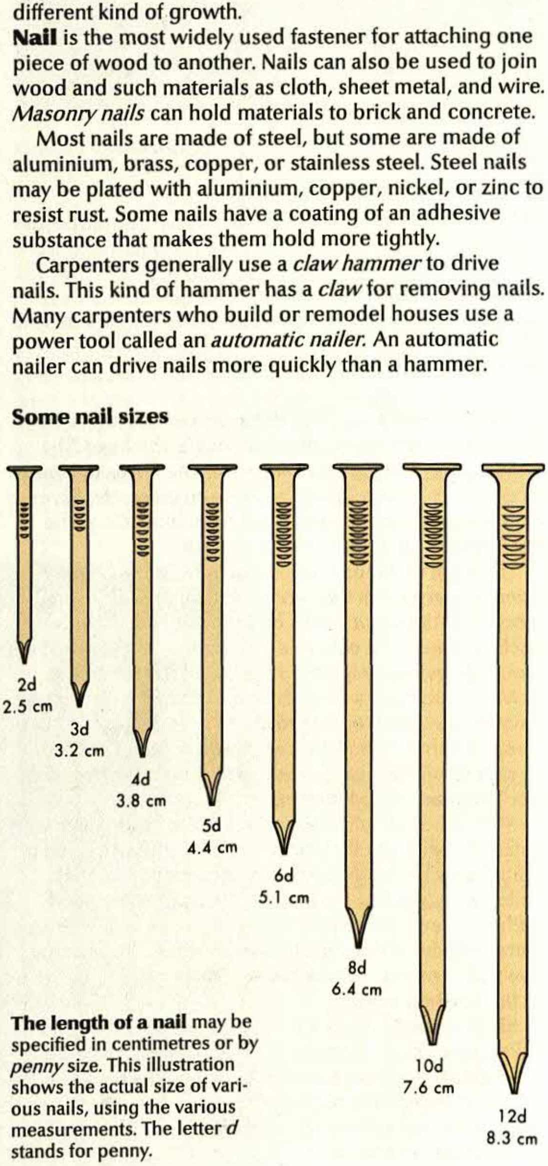
The horns, claws, talons, and hoofs of birds and animals are made of the same materials as the nails on the fingers and toes of the human body. Deer antlers are a different kind of growth.

Nail is the most widely used fastener for attaching one piece of wood to another. Nails can also be used to join wood and such materials as cloth, sheet metal, and wire. *Masonry nails* can hold materials to brick and concrete.

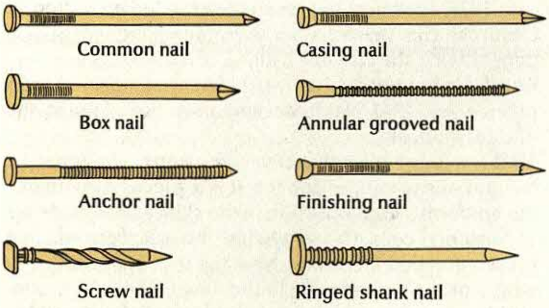
Most nails are made of steel, but some are made of aluminium, brass, copper, or stainless steel. Steel nails may be plated with aluminium, copper, nickel, or zinc to resist rust. Some nails have a coating of an adhesive substance that makes them hold more tightly.

Carpenters generally use a *claw hammer* to drive nails. This kind of hammer has a *claw* for removing nails. Many carpenters who build or remodel houses use a power tool called an *automatic nailer.* An automatic nailer can drive nails more quickly than a hammer.

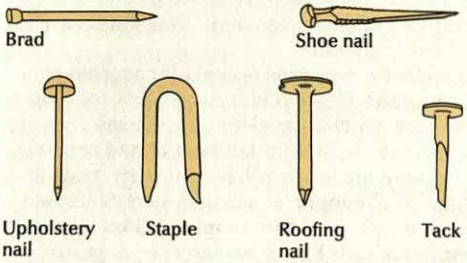
Some nail sizes



The length of a nail may be specified in centimetres or by *penny* size. This illustration shows the actual size of various nails, using the various measurements. The letter *d* stands for penny.



Nails have various shapes, depending on the purposes for which they are used. The different types of nails can be distinguished by their head, *shank* (body), and point.



Speciality nails and other metal fasteners are made for specific jobs. For example, they may be used in making shoes, in upholstering furniture, or to hold roofing materials.

The parts of a nail. A nail has three main parts: (1) the point; (2) the *shank,* or body; and (3) the head. The point acts as a wedge that separates the fibres of wood as the nail is driven. After the nail is in place, the fibres grip the shank and keep the nail from loosening. The head covers the hole made by the nail.

The most common type of nail point is the *diamond point,* a sharp point that works well in most kinds of wood. A *blunt point* works better in some hardwoods, such as maple and oak. This point breaks off some of the wood fibres and helps keep the wood from splitting.

Most nails have a smooth, round shank. Nails with a twisted, threaded, or ringed shank hold better but cost more. A narrow shank helps prevent splitting of hardwoods or of thin boards. Nails with a square shank are used to attach wood flooring to concrete.

Most kinds of nails have a broad, flat head. A nail with a narrow head can be hidden in the wood by driving it completely below the surface with a punchlike tool called a *nailset.* The hole left by the nail can be filled with putty and then painted. Roofers use a nail with an extra wide head to install tiles or shingles. Upholsterers use tacks with decorative heads if the tacks can be seen in the finished work.

Sizes of nails. Nails are sometimes measured in units called *pennies,* designated by the letter *d.* Nails measured in this way range in size from 2-penny nails that are 2.5 centimetres long to 60-penny nails 15 centimetres long. Nails that are shorter or longer than those are measured in centimetres. The system of measuring nails in pennies probably began in England several hundred years ago. No one knows the source of the penny unit. Some people believe a penny once stood for the weight of 1,000 nails. For example, 1,000 4d nails weighed 4 pounds. Others think the unit represented the price of 100 nails, so that 100 4d nails would have cost 4 pennies.

How nails are made. The earliest nails were made about 5,000 years ago in Mesopotamia. Artists used them to fasten sheets of copper to wooden frames to make statues. In the early 1700's, American colonists hammered nails by hand from a bar of hot iron. About 1775, Jeremiah Wilkinson, an inventor in Cumberland, Rhode Island, developed a process for cutting nails from a sheet of cold iron. About 1851, William Hassall (or Hersel), a machinist in New York City, invented the first machine for making nails from wire.

Today, almost all nails are made from wire by a machine that can produce more than 500 per minute. Wire is fed into the machine from a large coil. A set of cutters trims off a length of wire and forms the point of the nail at one end. At the same time, a hammer shapes the head at the other end. The nails are then polished, plated, or coated.

Naipaul, Shiva (1945-1985), a West Indian-born novelist, wrote about the loss of Hindu culture among Trinidadians of Indian descent. He was highly critical of Trinidad's colonial past.

Shiva Naipaul was born in Port-of-Spain, Trinidad, and was educated at Queen's Royal College and St. Mary's College. Like his older brother, the novelist V. S. Naipaul, he won a scholarship to Oxford University in England. Naipaul settled permanently in England. His first novel *Fireflies* met with high acclaim when it was published in 1970. The novel, which is set in Port-of-Spain, traces the decline of the fictional Khoja and Lutchman families. The book drew heavily on Naipaul's own family experience. Other novels by Naipaul are *The Chip Chip Gatherers* (1973), and *A Hot Country* (1983). *North of South* (1978) gives an account of his travels in Africa. In *Black and White* (1980), he showed exceptional social insight in dealing with the Jonestown massacre in Guyana, in 1978.

Shiva Naipaul

Naipaul, V. S. (1932-), a West Indian writer, became widely acclaimed for his novels set in the Caribbean and Africa, and for travel books. His work examines the subject of exile and raises questions about the relationship between culture and national identity. Naipaul's concern with colonialism, displacement, political violence, and alienation led critics to compare his work with that of the Polish-born author, Joseph Conrad.

Vidiadhar Surajprasad Naipaul was born in Trinidad, the grandson of Indian immigrants. He attended Queen's Royal College and won a scholarship to Oxford University, in England. He studied English. Naipaul settled in England and started a career as a literary journalist. He was knighted in 1990.

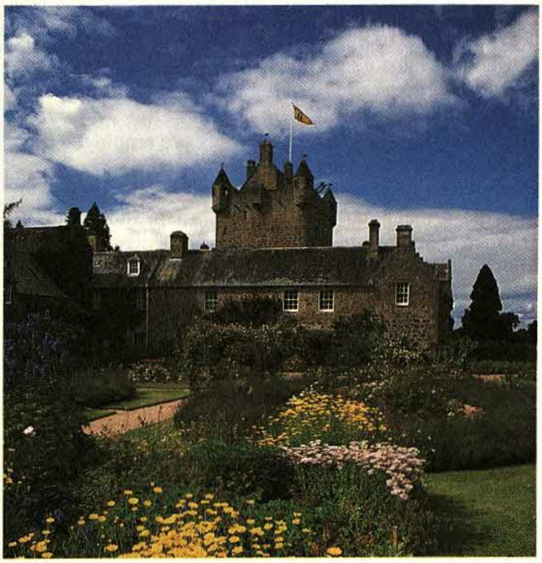
V. S. Naipaul

Naipaul's first three works, *The Mystic Masseur* (1957), *The Suffrage of Elvira* (1958), and *Miguel Street* (short stories, 1959), were all comedies of manners set in Trinidad. His growing reputation was confirmed with the publication of his next and best-known novel, *A House for Mr Biswas* (1961). The mild-mannered hero of this work was inspired by Naipaul's own father. The novel describes the dissolution of traditional family life as the younger generation leave home in favour of greater opportunities in Europe.

In a Free State (1971), won the Booker Prize, a major British literary award. The book explores the problem of finding a national identity within increasingly multiracial communities. Politics and violence formed the basis of his next novels, *Guerrillas* (1975) and *A Bend in the River* (1979).

Naipaul published travel books that deal with political and personal themes. They include controversial books about India: *An Area of Darkness* (1964), and *India: A Wounded Civilization* (1977).

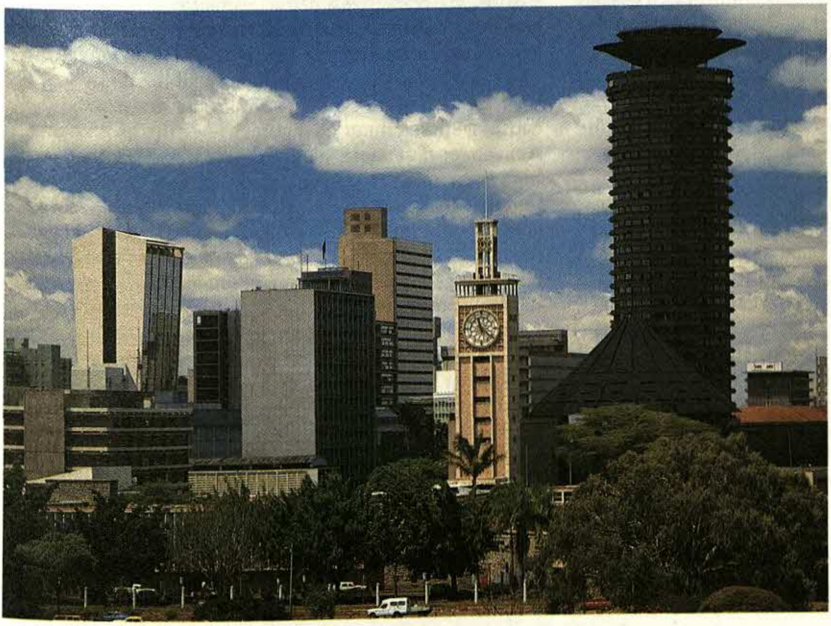
Nairn (pop. 10,680) is a local government district in Highland Region, Scotland. It occupies the same area as the former tiny county of Nairnshire, which was abolished in 1975. The former market town of Nairn, the district's administrative centre, is a seaside resort on the sea inlet of the Moray Firth, with good beaches, two championship golf courses, and hotels. Southwest of Nairn is Cawdor Castle, built in the 1400's. People fish for salmon and trout on the River Nairn. Local farmers are renowned for rearing fine beef cattle.



Cawdor Castle was built in the 1400's. It lies to the southwest of the market town of Nairn.

Nairobi (pop. 1,162,189) is the capital of Kenya and the most important commercial centre in eastern Africa. The city lies on a high plateau in south central Kenya.

The central area of Nairobi has many modern buildings, and its main streets are lined with trees. This area includes the parliament buildings, the Kenyatta Conference Centre, the Holy Family Cathedral, the Jamia Mosque, and hotels and commercial buildings. The National Museum and the University of Nairobi are north of the central area. Railway yards and an industrial area lie to the south. About 8 kilometres farther south, but still within the city, is Nairobi National Park. The park



Nairobi, the capital and largest city of Kenya, is a major African commercial centre. The city has many modern buildings, including the parliament buildings, offices, and places of worship.

covers 114 square kilometres of open land where lions, gazelles, gnus, zebras, and other wild animals live.

Many of Nairobi's people live in large, low-cost apartment complexes called *estates.* Other residents occupy single-family homes.

About a third of Nairobi's workers are employed by the Kenyan government. Industries in Nairobi produce beverages, cement, chemicals, clothing, foods, furniture, glass, machinery, paint, shoes, soap, and textiles. Tourism is an important part of Nairobi's economy. Many people visit the city to see Nairobi National Park and to take trips to other Kenyan game reserves. Nairobi is a centre for banking, trade, and other commercial activities. It also is an important railway centre.

Nairobi was originally the site of a water hole called *Enkare Nairobi,* which means *cold water.* The city became a railway centre in the early 1900's. In 1963, when Kenya became independent from Great Britain, the area of Nairobi expanded from about 90 square kilometres to 690 square kilometres. Nairobi's population has nearly tripled since 1962.

See also **Kenya.**

Naismith, James (1861-1939), a Canadian teacher who invented the game of basketball in 1891 (see **Basketball**). He wanted to develop a game that could be played indoors during the winter months. He tacked up two peach baskets and used a soccer ball for the first game. He invented the game when he was a physical-education teacher at the International YMCA Training School (now Springfield College), Springfield, Massachusetts, U.S.A.

Naismith graduated from McGill University in Montreal, Canada, in 1887. He was one of Canada's greatest Rugby and lacrosse players. He studied for the ministry, but became a physical-education teacher. He became director of physical education at the University of Kansas in 1898. He was born in Almonte, Ontario, Canada.

Najd. See **Saudi Arabia** (The Central Plateau; terrain map).

Namaqualand is a dry area along South Africa's western coast. It is best known for the display of 350 varieties of wildflowers which bloom each spring. Few people live in the region. It is named after the Namaqua tribe of the Khoikhoin people. The region stretches from the Swartland district in the south to the Orange River in the north.

Namaqualand has an extreme climate. There is little rainfall because the cold Benguela current of the Atlantic Ocean washes the coastline. At most, the area receives about 15 centimetres of rain a year. Between 1895 and 1898, no rain fell at all. Port Nolloth, on the Atlantic coast, is one of South Africa's driest places. It receives only about 6 centimetres of rain a year.

In the 1850's, the discovery of copper brought many miners to the area. In 1925, the world's richest deposits of alluvial diamonds were discovered at Alexander Bay at the mouth of the Orange River.

Namatjira, Albert (1902-1959), was an Australian Aboriginal painter. He was a member of the Aranda tribe in the Northern Territory. Rex Battarbee, an Australian artist, encouraged and guided him in learning to paint. F. W. Albrecht, a Lutheran missionary in the Northern Territory, promoted the style of Aboriginal painting that Namatjira developed. Namatjira's landscapes of the arid outback became extremely popular. He held his first exhibition of paintings in Melbourne and sold them all.

Albert Namatjira won fame for his paintings of the Australian outback. He inspired many other painters. This portrait of Namatjira was painted by William Dargie.

Name. Everyone has a name. Some people have many names. In most countries people have at least two names, a *given* name and a *family* name. The family name is a hereditary name borne by all the members of the family. It is also called a *surname* or *last name,* because in some countries it comes after the given name. A given, or *first name,* distinguishes between the members of a family. The given names, and the family name together make up a person's *legal name.* People in Asia and Africa often still give children names with specific meanings. Often they do not use family surnames. Names may be personal names, title names, or clan names. Traditional naming systems have often been modified to adapt to modern usage.

This article discusses the cultural and national characteristics of names and describes their origins.

Given names

Many common given names in the West come from Hebrew, Greek, or Latin, or from Teutonic languages.

Hebrew names taken from the Bible have provided the most important source of Christian names. The most common boy's name is *John,* which means *gracious gift of God.* The most common girl's name is *Mary,* which may mean *bitter.* Other common Hebrew names include

The origin and meaning of some common given names from around the world

This table shows the origin and probable meaning of a number of given names. Many names are so old that scholars can only guess at their meaning.

Name	Origin	Meaning
Abdul	Arabic	servant
Ahimsa	Hindi	reverence for all life
Akako	Japanese	red
Alexander	Greek	helper of humanity
Ali	Arabic	Allah, god
Amy	French	beloved
Andrew	Greek	manly
Ann, Anne	Hebrew	grace
Anthony	Latin	praiseworthy or priceless
Barbara	Greek	stranger
Benjamin	Hebrew	son of the right hand
Bo	Chinese	precious
Brian	Celtic	strong
Carl, Charles	Teutonic	man
Catherine	Greek	pure
Chandra	Sanskrit	goddess brighter than the stars
Christopher	Greek	Christ bearer
Daniel	Hebrew	God is my judge
Deborah	Hebrew	bee
Dennis	Greek	of Dionysus, the Greek god of wine
Dorothy	Greek	gift of God
Douglas	Celtic	dark water
Edward	Teutonic	rich guardian
Elaine, Ellen	Greek	light
Elizabeth	Hebrew	oath of God
Emily	Latin	industrious
Eric	Teutonic	kingly
Francis, Frank	Teutonic	free
Frederick	Teutonic	peaceful ruler
George	Greek	farmer
Gerald	Teutonic	strong with a spear
Gloria	Latin	glorious
Harold	Teutonic	warrior
Hassan	Arabic	handsome
Helen	Greek	light
Henry	Teutonic	ruler of the home
Hiroshi	Japanese	generous
Ho	Chinese	good
Hussein	Arabic	good
Jamal	Arabic	beauty
James	Hebrew	may God protect, or one who takes the place of another
Jane, Janet	Hebrew	gift of God
Jean	Hebrew	gift of God
Jeffrey	Teutonic	God's peace
Jennifer	Celtic	white wave
Jivanta	Sanskrit	long-lived
Joan	Hebrew	gift of God
John	Hebrew	God's gracious gift
Joseph	Hebrew	the Lord shall add
Judith, Judy	Hebrew	Jewish woman or praised
Julia, Julie	Latin	downy face
Karen	Greek	pure
Laura	Latin	laurel
Lim	Chinese	forest
Lois	Greek	desirable
Lok	Chinese	happiness
Ma	Chinese	horse
Margaret	Greek	pearl
Mark	Latin	of Mars, the Roman god of war
Mary	Hebrew	bitter
Matthew	Hebrew	gift of God
Melanie	Greek	black
Michael	Hebrew	godlike
Nancy	Hebrew	grace
Noel	French	Christmas child
Omar	Arabic	longlife
Patricia	Latin	of noble birth
Paul	Latin	little
Philip	Greek	lover of horses
Rachel	Hebrew	ewe
Rana	Sanskrit	prince
Richard	Teutonic	rule, hard
Robert	Teutonic	bright fame
Ronald	Teutonic	advice, power
Samuel	Hebrew	God has heard
Sara, Sarah	Hebrew	princess
Seif	Arabic	sword of religion
Steven, Stephen	Greek	crown or garland
Susan, Susannah	Hebrew	lily
Teresa, Theresa	Greek	harvester
Theodore	Greek	gift of God
Thomas	Aramaic	twin
Vanita	Sanskrit	wished for
Virginia	Latin	pertaining to spring
Walter	Teutonic	powerful ruler
William	Teutonic	will, helmet

David (beloved), *Elizabeth* (oath of God), *James* (may God protect, or one who takes the place of another), and *Joseph* (the Lord shall add), *Hannah* (God has favoured me), and *Samuel* (God has heard). These Biblical names occur in various forms among all Christian nations.

Greek and Latin names often refer to abstract qualities. Common Greek names include *Alexander* (helper of humanity), *Barbara* (stranger), *George* (farmer), *Helen* (light), *Margaret* (pearl), *Philip* (lover of horses), and *Stephen* (crown or garland). Latin names include *Clarence* (famous), *Emily* (industrious), *Patricia* (of noble birth), *Victor* (conqueror), and *Virginia* (pertaining to spring).

Teutonic names are widely used and are among the most popular Christian names, especially boys' names. They usually consist of two elements joined together without regard to their relationship. For example, *William* is composed of two name elements, *Wille* (will, or resolution) and *helm* (helmet). But the name *William* does not mean "helmet of will" or "resolute helmet." It means "will, helmet." Some of these name elements are found at the beginning, as *ead* (rich) in *Edwin* and *Edmund.* They may also occur at the end, as *weard* (guardian) in *Howard* and *Edward.*

Other given names. Family names may often be used as Christian names. Such names as Percy, Sydney, and Lincoln are now recognized Christian names.

Traditionally, Roman Catholic parents have given a saint's name to a child. This is not difficult, because most common Christian names now have been borne by one or more saints.

Indian names are complicated. Until the late 1800's, the idea of a surname was foreign to Indian custom. A modern Indian name can have several elements. There are no rules about the sequence of names or about which should be regarded as the "surname". Spellings of the same name can vary within a single family. A person usually has one or two personal names, which may be written as two words or one. These are given at birth. They are usually followed by a complementary name, or name which may indicate caste, tribe, *gotra* (descent from a common ancestor), place or region of birth or residence, profession, trade, or religious sect. Many Hindus take the name of a Hindu god or goddess. An inherited title may also become part of a name, as may an educational qualification. Writers in particular often use pseudonyms or pen-names.

Muslim names consist of a proper name, followed by a *nasab,* a particle referring to a forebear. For example, *ibn* means "son of"; *bint* means "daughter of". This is followed by the actual name of the father, grandfather, or other ancestor as far back as a person wishes to claim lineage. To this ancestral name may be added an indirect *honorific* name *(kunyah).* This consists of a particle (*abu* meaning "father of"; *umm* meaning "mother of") and the name of one's oldest or most prestigious male descendant. A further addition might be a term of association *(nisbah),* consisting of a birth-place (ar-Razi meaning "from the town of Rayy"), a profession (al-Khayyam meaning "the tentmaker"), a clan or tribe (al-Hashimi, "of the Hashemites"), or a spiritual distinction (al-Ansari "of the first Muslim converts"). Muslim rulers in the past often adopted a ceremonial name or *laqab,* such as al-Mansur, "the Victor".

Sikh names. Sikhs have a family name that comes from the father's side, for example, Chahal. A son will have a personal name, such as Balwant, followed by a title name, Singh. Guru Govind Singh gave his followers common family names: Singh (Lion) for all men and Kaur (Princess) for all women. Because these names are so common, they have become titles, and occur at the middle or end of the name.

Malaysian and Indonesian names. Most Malaysian Muslims do not use family surnames. The commonest name for boys is Muhammad (the name of the Prophet), and for girls is Fatimah (the name of the Prophet's daughter).

Children's names may be changed, for example, if a child is prone to illness. Women do not change their names on marriage. Some common abbreviations of Muslim names are A (Abdul, Abu, Ahmad or Ali), M or Md (Muhammad), and S (Syed or Syarifah). Malays sometimes shorten familiar names by dropping the first syllables, so Abdullah may be shortened to Dollah or Lah.

Javanese do not have traditional surnames. Most Javanese are Muslims, but they do not usually use names of Arabic origin. They prefer names of Sanskrit or Javanese origin. Javanese names often begin with *Su-* and may end in *-o.* Examples are Sukarno, Suharto, Suprapto. Names of women commonly end in *-i,* for example Sundari, Kartini. Most Javanese use only one name. Examples are Mr Supomo or Mr Ibrahim. But some Javanese use two names; one Muslim, and one Javanese, for example, Achmed Sukarno.

A Javanese child is given a simple, single name which he or she carries until marriage. Some of these names are typical "village" names. At marriage, a man assumes a *jeneng tuwa* or "old name". A doctor might take the name *husodo* ("medicine"), and be called *kartohusodo.* Nowadays, Javanese "old names" may be used as surnames.

Filipino names. Filipinos had only personal names before the Spanish colonization of the 1500's. Now, most people have Christian first names, often chosen from the Roman Catholic calendar of saints' days. In the mid-1800's, the Spanish enforced the taking of Spanish surnames, so Filipinos have names such as Victor Cruz or Gabriel Santos. Muslims in the Philippines use traditional Muslim names.

Chinese names. The Chinese living in Malaysia, Singapore, and other parts of Southeast Asia use a system of names similar to that used in China. They usually have three names.

Informally, a Chinese may be known by only his given names; so Yew Kim Seong may be called Kim Seong. Also, the word "Ah" may be used in place of the middle name, so Wong Sam Moy may be called Ah Moy by her friends. Chinese may write their family name last, like a Western surname. So Lim Hen Peng may write his name as Hen Peng Lim, or even H.P. Lim. Muslim Chinese often have the surname Ma ("horse"). They may use a Muslim name with their Chinese surname, such as Ibrahim Ma. Chinese people may also use a Christian name with their Chinese surname, such as John Lim.

In Indonesia, the spelling of Chinese names follows Dutch convention. So, for example, Malaysian Lee is Indonesian Lie; Yap is Jap, and so on. Many Indonesian citizens of Chinese descent have changed their names to Indonesian names.

Chinese living in the Philippines use the usual Chinese naming system with the surname first—such as Chua Niu San, Ang Hui Lan, Tan Siu Eng. The spelling of some names is different from that used in Malaysia and Singapore.

History of family names

Beginnings. The Chinese were the first known people to acquire more than one name. The Emperor Fuxi is said to have decreed the use of family names, or *surnames,* about 2852 B.C. The Chinese customarily have three names. The family name, placed first, comes from one of the 438 words in the Chinese sacred poem *Baijia Xing* (also spelled *Po-Chia Hsing*). It is followed by a *generation name,* taken from a poem of 20 to 30 characters adopted by each family; and a *milk name,* corresponding to a Christian name.

In early times, the Romans had only one name, but later they also used three names. The *praenomen* stood first as the person's given name. Next came the *nomen,* which indicated the *gens,* or clan. The last name, the *cognomen,* designated the family. For example, Caesar's full name was *Gaius Julius Caesar.* A person sometimes added a fourth name, the *agnomen,* to commemorate an illustrious action or remarkable event. Family names became confused by the fall of the Roman Empire, and single names once again became customary.

The Middle Ages. In Europe, family names came into use again in northern Italy about the late A.D. 900's, and became common about the 1200's. Nobles first adopted family names to set them apart from the common people. The nobles made these family names hereditary, and they descended from father to children. The nobility called attention to their ancestors in this way. A family name became the mark of a well-bred person, so the common people began to adopt the practice too.

Throughout Europe, wealthy and noble families first adopted family names. At first, these were not hereditary, but merely described one person. For example, the son of Robert Johnson might be known as Henry Robertson, or Henry, son of Robert.

Origin of family names

It is difficult to work out a simple classification of family names, because of corruption and changes in spelling and pronunciation. Many old words are now obsolete or have obsolete meanings. For many years, the spelling of names depended on the discretion of the writer. The same name might be spelled in different ways in the same document. Some names appear to come from English words, but they are from another language. Foreign names are often altered into more familiar words. The Dutch *Roggenfelder* (dweller in or near a rye field) became the American *Rockefeller.*

Family names have come down to us in various ways. They may have grown out of a person's surroundings or job, or the name of an ancestor.

Place names came from a person's place of residence. For example, if a man lived on or near a hill or mountain, he might be Mr. *Maki,* if from Finland; Mr. *Dumont* or Mr. *Depew* in France; Mr. *Zola* in Italy; Mr. *Jurek* in Poland; or Mr. *Hill* in England. In England, people might be known as *Wood, Lake, Brook, Stone,* or *Ford* because of their location.

During the Middle Ages, few people could read. Signboards often exhibited the picture of an animal or object to designate a shop or inn. A person working or living at the place might be called *Bell, Star,* or *Swan.* A person might also be named after the town he or she came from, such as *Middleton* or *Kronenberg.* Many English place names may be recognized by the endings *-ham, -thorp, -ton, -wic,* and *-worth,* meaning a homestead or dwelling.

Occupation. Family names also come from a person's job. Names like *Baker, Carpenter, Clarke, Cook, Miller,* and *Taylor* are quite common.

The most common surname in English is *Smith.* It is also common in many other countries. It takes the form of *Schmidt* in Germany, *Lefevre* in France, *Ferraro* in Italy, and *Kuznetzvo* in Russia.

Ancestor's name. Many people took surnames from their father's given name. Practically every language has a suffix or prefix meaning "son of." Some names that include the term "son of" include Irish names beginning with *O',* German names ending in *-sohn* or *-son,* and Scandinavian names ending in *-sen* or *-son.* Russian and Serbian names ending in *-ovitch* and Romanian names ending in *-escu* have the same meaning. Those describing the bearer of the name as the *son of John* include *Johnson* and *Jackson* in England; *Johns* and *Jones* in Wales; *Jensen, Jansen,* and *Hansen* in Denmark; *Jonsson* and *Johanson* in Sweden; *Janowicz* in Poland; *Ivanov* in Russia and Bulgaria; *Janosfi* in Hungary; and *MacEoin* in Ireland.

Many surnames came from terms that described an ancestor. *Robert Small* probably had an ancestor called *Robert, the small. Names like Reid, Reed,* and *Read* are early spellings of "red" and refer to a man with red hair. These red-haired men probably received the nickname of "Red".

Other family names may have more than one origin. For example, the common English surname *Bell* may designate one who lived or worked at the sign of the bell, or it may refer to the bellmaker or bellringer. It may also indicate the descendant of *Bel,* or pet form of *Isabel,* or it may be a nickname for *the handsome one,* from the Old French word *bel,* or beautiful.

Jewish family names were the last to develop in most Western countries. In Europe, Jews usually lived apart from others. Many did not feel the need for family names. Laws passed in the early 1800's compelled them to adopt surnames. Many Jews then chose pleasant combinations of various words like gold, silver, rose *(rosen),* mountain *(berg),* stone *(stein),* and valley *(thal),* to form such names as *Goldberg, Silverstein,* and *Rosenthal.* Others took surnames from given names, such as *Benjamin* and *Levy.*

Other names

Nicknames may be either descriptive terms or pet names. Descriptive terms, such as *Happy* and *Ginger,* usually express a person's prominent characteristics. Physical characteristics account for the largest group of nicknames. Sometimes they go by contraries, as when a big, strong person is called *Tiny.* Sometimes a nickname results from a child's attempt to pronounce a word or name, as *Lilibet* for Elizabeth. A nickname may also be a translation of the person's real name.

Pseudonyms are fictitious names assumed for anonymity or for effect. A *nom de plume* (pen name) is the pseudonym of a writer. Many prominent authors have assumed pen names. For example, *Voltaire* was the pen name of François Marie Arouet. Eric Blair, an English writer, wrote under the name of *George Orwell.* See **Pen name.**

An *alias* usually refers to the name taken by a criminal to disguise his or her identity. *Incognito* means the use of a fictitious name by a person, usually a celebrity, to avoid being recognized.

Stage names are names that some entertainers assume in their professions. The French actress *Sarah Bernhardt's* original name was Rosine Bernard. Many film stars have changed their names. Frances Gumm was better known as *Judy Garland.*

Namib Desert, the oldest desert in the world, lies along southern Africa's west coast, mainly within Namibia. The desert covers more than 270,000 square kilometres. It extends from the Orange River in the south to Angola in the north. The Atlantic Ocean is the western limit. The steep slopes known as the Namibian escarpment make up the eastern edge.

The desert has the highest sand dunes in the world. Some of them rise to more than 400 metres. The Skeleton Coast, which forms part of the northern region, received its name because of the large number of shipwrecks which occurred there.

The Namib Desert has a harsh climate. Mists and fog are frequent, but little rain falls. The coastal strip receives less than 2 centimetres of rain a year.

The main towns are Swakopmund, Walvis Bay, Lüderitz, and Oranjemund. Diamonds were discovered in 1904 and diamonds are still mined on the beaches. But former diamond settlements, such as Kolmanskop and Elizabeth Bay, are now ghost towns being covered by shifting sands.

Namibia is a country in southwestern Africa. It was formerly named South West Africa. Namibia covers 823,168 square kilometres.

Most of Namibia's people are blacks, but the territory was controlled by the white government of neighbouring South Africa from 1916 to 1990. In March 1990, after many years of negotiations, Namibia gained full independence from South Africa.

Much of Namibia's land is dry and unfertile. However, the land is rich in mineral deposits, including diamonds and uranium. Windhoek is the capital and largest city in Namibia.

Government. Namibia's government is headed by a president. Shortly before independence, Namibia's first president was elected by the National Assembly (then called the Constituent Assembly). Later presidents are to be elected by the people. The president may serve a maximum of two five-year terms. Namibia's legislature consists of two groups—the National Assembly and the National Council. The National Assembly writes the nation's laws, and the National Council reviews them. The National Assembly has 72 members, elected by the people to five-year terms. The National Council has 26 members. Each of the country's 13 regional councils elects 2 members of the National Council to six-year terms. Regional council members are elected by the people. The president of Namibia appoints a prime minister from among the members of the National Assembly. The prime minister leads the assembly and assists the president in functions of government.

Namibia's most powerful political party is the South West Africa People's Organization (SWAPO). The main opposition party is the Democratic Turnhalle Alliance (DTA).

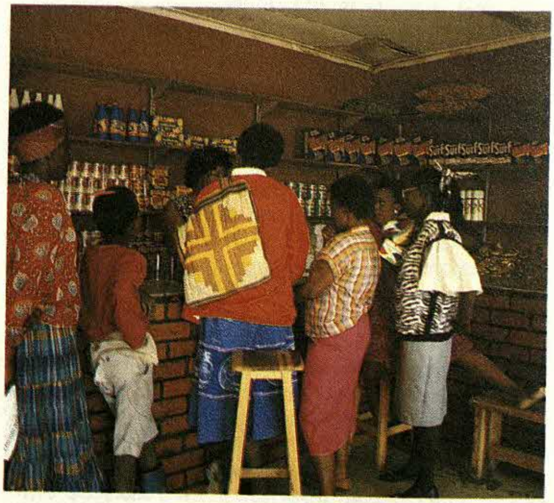
Namibia has about 7,500 people in its army, the Namibia Defence Force. Service in the army is voluntary.

People. For Namibia's total population, see the *Facts in brief* table with this article. About 72 per cent of Namibia's people live in rural areas, and about 28 per cent live in urban areas. Blacks make up more than 90 per cent of the population. Whites account for only about 7 per cent.

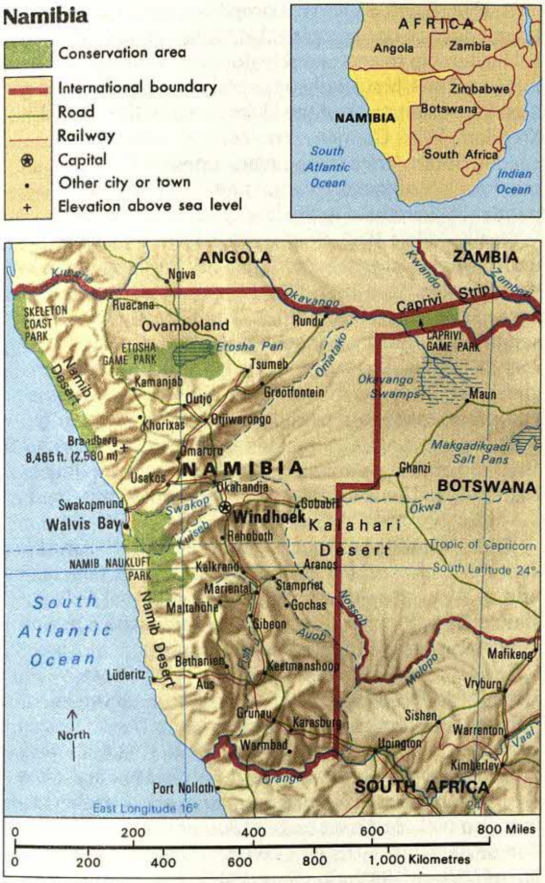
Namibia's blacks belong to a number of different ethnic groups. The Ovambo (also spelled Owambo) form the largest group. They comprise over half of the Namibian population. The Ovambo live in the north, near the Angolan border. This region is called Ovamboland or Ovambo. Other northerners in the country include the Kavango, who live near the Okavango River; and the Caprivians, who inhabit the eastern end of the narrow strip of land that is called the Caprivi Strip. The Damara and the Herero occupy central Namibia. San (Bushmen) and Tswana people live along the country's eastern border. Two groups of people of mixed ancestry live south of Windhoek—the Basters, who live in or near Rehoboth; and the Nama, who inhabit the far south.

Namibia's whites include South Africans of Dutch, English, and German descent. Namibia's population also includes people of mixed ancestry from South Africa who are called Coloureds. Most of the whites and Coloureds live in or near cities or towns.

Namibia is a country in southwestern Africa. Windhoek, *above,* is the capital and largest city.



A small shop in a Namibian village, *above,* provides a relaxed meeting place for local people.


Namibia

Most people of northern Namibia fish, grow crops, and rear livestock for a living. Many Ovambo and Kavango men also work in copper mines at Tsumeb or in diamond mines near the southern border. Most of the rural people south of Ovamboland farm and rear livestock. Many of Namibia's whites hold administrative jobs in urban areas. The standard of living among Namibia's black ethnic groups varies, but most of the black people must struggle to make a living. Whites generally have higher incomes than do blacks. But when Namibia gained independence, the government began working to raise the economic level of the blacks.

Namibia's official language is English. However, most black Namibians speak the African languages of their homelands. About 15 such languages are spoken in the country. Approximately 90 per cent of the people are Christians. Lutherans form the largest Christian denomination. Other Christian groups, in order of size, are Roman Catholics, Anglicans, and members of Dutch Reformed Churches.

State schools provide Namibians with free education. The University of Namibia (formerly the Academy for Tertiary Education) offers post-secondary education.

Land and climate. Namibia is bordered on the north by two large rivers, the Kunene and the Okavango. The Kwando River cuts through the Caprivi Strip. The Zambezi River flows along the northeastern border, and the Orange River forms Namibia's southern border.

Facts in brief about Namibia

Capital: Windhoek.
Official language: English.
Official name: Republic of Namibia.
Area: 824,292 km². Greatest distances—east-west, about 1,420 km; north-south, about 1,320 km. *Coastline*—1,489 km.
Elevation: *Highest*—Brandberg, 2,580 m above sea level. *Lowest*—sea level, along the coast.
Population: *Estimated 1996 population*—1,739,000; density, 2 people per km²; distribution, 69 per cent rural, 31 per cent urban. *1991 census*—1,401,711. *Estimated 2001 population*—2,021,000.
Chief products: *Agriculture*—cattle, fish, sheep, maize, millet, vegetables. *Mining*—copper, diamonds, lead, uranium oxide, zinc.
Flag: A large blue triangle is in the upper left corner, and a large green triangle is in the lower right corner. A sun appears on the blue triangle. The triangles are separated by a red diagonal stripe bordered by white. Adopted 1990. See **Flag** (picture: Flags of Africa).
Money: *Currency unit*—Namibia dollar. One dollar = 100 cents.

The western border of Namibia stretches about 1,500 kilometres along the Atlantic Ocean. Huge sand dunes of the Namib Desert lie near the coast. The Kalahari Desert occupies eastern Namibia. The inland territory is mostly a rolling plain about 1,200 metres above sea level. This area has stubby trees and enough grassland for grazing cattle and growing maize.

Large antelopes live on the interior plain of Namibia. Elephants adapted to desert conditions inhabit the northwest corner of the country. Etosha Game Park, a huge reserve in north-central Namibia, has a variety of animals, including antelopes, cheetahs, elephants, giraffes, lions, rhinoceroses, and zebras.

Daytime temperatures in Namibia average 24 °C in January and 20 °C in June. Namibia receives most of its rain between December and March. The average annual rainfall totals about 50 centimetres in the north and about 20 to 40 centimetres in the centre. Southern Namibia receives only about 2.5 to 15 centimetres of rain a year.

Herero women in clothing based on those given to them by German Lutheran missionaries in the 1800's.

Economy. Mining is among Namibia's most important economic activity. The chief minerals are diamonds, uranium, copper, lead, tin, and zinc. Traditionally, farming, livestock rearing, and fishing have also been important economic activities. But since the late 1970's, drought and other problems have reduced farming and livestock activities, and overfishing has reduced fishing in the Atlantic.

Most farmers grow only enough food crops for their own use. The chief farm crops include maize, millet, and vegetables. Cattle and sheep are the most important livestock. The fishing industry yields anchovies, mackerel, and sardines. Little manufacturing takes place.

Namibia's leading exports include jewellery diamonds, uranium oxide, copper, lead, and zinc. Imports include wheat and other foods, and manufactured products. Namibia's trading partners include South Africa, Japan, the United States, and the United Kingdom.

Walvis Bay is the chief port. Namibia has about 2,330 kilometres of railways that connect its major urban areas with one another and with South Africa. The territory also has about 38,600 kilometres of roads, fewer than one-fourth of which are paved. An international airport operates near Windhoek.

History. Both the Damara and the San people claim to be the original inhabitants of Namibia. Through the years, large numbers of Herero and Ovambo people moved to Namibia from the north. By the 1800's, the Damara, Herero, and Ovambo were the largest groups, and the Kavango and the Caprivians had settled where they now live. Other groups arrived and settled in the 1800's.

Beginning in 1868, German settlers, missionaries, and soldiers colonized Namibia's coast. Germany annexed the land in 1884, calling it German Southwest Africa. During the 1890's, the Germans brutally forced the Herero and Damara out of the Windhoek area. The Herero began to revolt in 1904. By the time the Germans put down the revolt—in 1907—they had killed about 65,000 Herero.

In 1915, during World War I, South African troops attacked the Germans and took over Namibia. The South Africans wanted to make Namibia part of their country. But the United States and other allied nations objected to that plan. In 1920, the newly formed League of Nations gave South Africa a mandate to manage Namibia's government and affairs. Yet, the South Africans governed Namibia as if the nation were a province of their nation.

The UN replaced the League of Nations in 1945. But South Africa refused to accept the authority of the UN and rejected its request to place Namibia under UN trusteeship. The UN tried repeatedly to bring Namibia under UN control. In 1966, the UN voted to end South Africa's mandate. In 1971, the International Court of Justice declared South Africa's control of Namibia illegal.

Black Namibians formed a political organization called the South West Africa People's Organization (SWAPO) in 1960. At first, SWAPO tried to persuade South Africa to grant Namibia independence. But beginning in the mid-1960's, it used guerrilla tactics to further its goal. In turn, South Africa set up armed forces along Namibia's borders with Angola and Zambia. Fighting occurred between SWAPO and South Africa until 1989.

In 1977, South Africa was preparing to grant Namibia independence under a plan that would give local political leadership to an assembly dominated by white Namibians. The UN strongly opposed such white domination. Representatives of the United States, the United Kingdom, West Germany, France, and Canada persuaded South Africa to negotiate a new plan that would meet the UN objection. Various negotiations for independence were held in the late 1970's and the 1980's.

Finally, in late 1988, South Africa agreed to a plan under which Namibia would gain full independence by April 1990. In April 1989, SWAPO and South Africa agreed to a cease-fire. Elections for a Constituent Assembly in Namibia were held in November 1989. In February 1990, the Assembly approved a constitution and chose Sam Nujoma, the leader of SWAPO, as Namibia's first president. Future presidents are to be elected by the people. Namibia gained independence on March 21, 1990 and became a member of the Commonwealth of Nations. The Constituent Assembly was then renamed the National Assembly.

When Namibia became independent, South Africa kept the district of Walvis Bay, which included the major port of Walvis Bay. Namibian leaders said Walvis Bay should be part of Namibia. In 1994, South Africa turned over control of Walvis Bay to Namibia.

See also **South Africa; Walvis Bay; Windhoek.**

Namier, Sir Lewis (1888-1960), was one of the most influential historians of his day. His book *The Structure of Politics at the Accession of George III* (1929) showed his intimate knowledge of British political history in the Georgian period. His important works on Georgian history also include *Crossroads of Power* (1962), a collection of 20 lectures. His other works include *In the Margin of History* (1939), *Conflicts* (1942), *Avenues of History* (1952), *In the Nazi Era* (1952), *Personalities and Powers* (1955), and *Vanished Supremacies* (1958). Namier was born in Russia. He studied at Oxford University.

Nan-ching. See **Nanjing.**

Nanak (1469-1539) was the first *guru* (teacher) of the Indian religious sect known as the *Sikhs.* He was born in Nankana, a village west of Lahore (now in Pakistan). Stories of his life were later collected by the Sikhs in books called *janamsakhis.*

About the year 1500, Nanak experienced what he claimed was a revelation from God. This led him to declare that "There is no Hindu, there is no Muslim." It marked the start of his mission, and eventually resulted in the founding of the new religion of Sikhism. Nanak travelled widely for many years. During his wanderings he met holy men and preached his message. Later, he founded the first community of *Sikhs* (disciples).

Nanak composed nearly 1,000 hymns in a mixture of Old Punjabi and Old Hindi. The hymns were later collected in the Sikh holy book, the *Adi Granth.* His most famous hymn is the *Japji,* which Sikhs recite at dawn each day. The hymn praises the power and majesty of the one God, and teaches how the people of the world can be saved by being open to His grace. Nanak declared that neither Hinduism nor Islam could guarantee salvation. The only way to be saved was by worshipping God both privately and listening to hymns in the temple. In addition, a true believer should carry out his normal work properly, give what he could to those in need, and live a clean and upright life. These teachings are summed up in the famous threefold formula of *nam dan isnan,* meaning "the Name, giving, bathing."

Sikhs revere Nanak as the founder of their religion, and the temples built at his birthplace are the centre of an annual pilgrimage.

See also **Adi Granth; Sikhism.**

Nancy (pop. 96,317; met. area pop. 306,982) lies 282 kilometres east of Paris. For location, see **France** (political map). Nancy is the commercial centre of Lorraine because it is on the Eastern and Marne-Rhine canals and on the Meurthe River, 10 kilometres above its junction with the Moselle River. Factories there make furniture, glassware, and electrical equipment. The city has a university, founded in 1572, and a school of forestry and mining.

Nanjing (pop. 2,210,000), also spelled *Nan-ching* or *Nanking,* is an important centre of industry, transportation, and government in east-central China. The city lies on the Yangtze River, about 320 kilometres from the East China Sea. For location, see **China** (political map). Nanjing is the capital of Jiangsu Province and was once the capital of all China.

The city. Government office buildings, two museums, and a stadium are in the centre of Nanjing. Commercial and residential areas lie outside the central area. Most of Nanjing's people live in flats or above shops. The remains of an ancient defensive wall surround the built-up areas of Nanjing. Areas of farmland outside the wall are included in the city limits.

Most of Nanjing's people travel by bicycle or public bus. Trucks transport most products in the city, but some goods travel in carts pulled by animals.

Wharves that can handle oceangoing ships line the banks of the Yangtze River, which borders Nanjing on the west. East of the city are Xwanwu Lake, a tourist attraction with several islands; and Zijin Mountain, the site of an astronomical observatory. The tomb of Sun Yat-sen, who helped establish the Republic of China in 1912, lies on the mountain. Nanjing's educational institutions include Nanjing University, engineering colleges, and a medical school.

Economy. Nanjing has hundreds of manufacturing plants. Leading products are cement, fertilizers, iron and steel, porcelain, textiles, and trucks. Nearby mines provide iron ore for the iron and steel plants. Several *communes* (farm communities) operate outside the city. The farmers raise cotton, rice, wheat, vegetables, and other crops.

Railways link Nanjing to Beijing, the capital of China, in the north and to Shanghai in the east. Many ships dock at the city's wharves. A double-deck bridge that extends 5 kilometres across the Yangtze serves trains and motor vehicles.

History. People have lived in what is now the Nanjing area since about the 400's B.C. Early settlers chose the site because of its location near a river and some roads. From A.D. 420 to 1421, the city served as the capital of various local Chinese *dynasties* (series of rulers of the same family). The Ming dynasty gained control of most of China in 1368. The first Ming ruler made Nanjing—which means *southern capital*—the seat of the dynasty. In the early 1400's, the Mings moved the capital to Beijing—which means *northern capital.*

The tomb of Sun Yat-sen lies on Zijin Mountain, east of Nanjing. Sun helped establish the Republic of China in 1912.

In 1853, rebels called the Taipings seized Nanjing from the Manchus, who ruled China at that time. The Taipings made the city the capital of their empire. The Manchus regained Nanjing in 1864.

In 1912, Chinese revolutionaries overthrew the Manchus. The new rulers met in Nanjing and founded the Republic of China. From 1928 to 1937, the city served as the capital of the republic. Japanese forces captured Nanjing in 1937 and burned much of the city. Nanjing again became China's capital in 1946, the year after Japan's surrender ended World War II.

The Chinese Communists took over China in 1949. They made Beijing the capital, but Nanjing remained a centre of regional government. During the 1950's, 1960's, and 1970's, the Communists built hundreds of manufacturing plants in Nanjing. The city quickly grew into a major industrial centre.

Nanking. See **Nanjing.**

Nansen, Fridtjof (1861-1930), was a famous Norwegian polar explorer. He was also a humanitarian, a statesman, a marine zoologist, and a pioneer oceanographer.

He made his first Arctic cruise in 1882 as a zoological collector aboard a whaler. In the summer of 1888, he and five other men crossed Greenland from east to west, a feat experts had declared impossible.

Nansen hoped to obtain valuable scientific information by exploring the North Polar Basin. For this expedition, he had a ship specially built to withstand the grinding ice floes. This ship was named the *Fram* (Forward). Nansen left Norway in the *Fram* on June 24, 1893. After two years aboard ship, he and Hjalmar Johansen tried to reach the North Pole with kayaks and sledges. They came within 438 kilometres of the pole, nearer than anyone before them. After meeting many dangers, they boarded a British ship at Franz Josef Land in 1896 and went to Norway. See **Arctic Ocean** (maps).

Nansen played a prominent part in the separation of Norway from Sweden in 1905. From 1906 to 1908, he served as Norwegian minister to the United Kingdom. On his return to Norway, he became a professor of marine zoology (later oceanography) at the University of Christiania. He went on ocean voyages in 1910, 1912, 1913, and 1914, and published his results in many books. His writings include *Farthest North* (1897) and *In Northern Mists* (1911), a history of Arctic exploration.

After World War I (1914-1918), Nansen served as Norwegian delegate to the League of Nations. He aided Soviet refugees in Asia Minor, and directed the return of German and Soviet war prisoners to their homelands. He devised an identification certificate for refugees, called the *Nansen passport.* He received the 1922 Nobel Peace Prize for his services. Franz Josef Land in the Arctic Ocean is often called Fridtjof Nansen Land. Oceanographers use a metal container, called a *Nansen bottle* in honour of him, to trap seawater. Nansen was born in Christiania (now Oslo).

Nansen bottle. See **Ocean** (Oceanography; picture: Chemical oceanographers).

Nantes (pop. 252,029; met. area pop. 492,255) is a port city in western France, near the mouth of the Loire River. For the location of Nantes, see **France** (political map). A ship canal connects the city with the port of St.-Nazaire on the Bay of Biscay, an arm of the Atlantic Ocean.

Shipping and shipbuilding are the major industries. Other economic activities include food-processing and the production of copper, steel, and aviation and railway equipment. The city is the capital of the Loire region and the Loire-Atlantique department (administrative district). The city's landmarks include a castle, built in the 1400's; and the Cathedral of St. Peter and St. Paul, which also dates from the 1400's.

Gauls built a town on the site of what is now Nantes many years before Roman soldiers established a settlement nearby in the 50's B.C. In A.D. 1598, King Henry IV of France signed the famous Edict of Nantes in the city's castle. The edict granted limited religious liberty to Protestants (see **Nantes, Edict of**).

Nantes, Edict of, was the first official recognition of religious toleration by a great European country. King Henry IV of France signed the edict in the city of Nantes on April 13, 1598. Before the edict was signed, there had been 50 years of internal warfare and religious division in France. The edict allowed French Protestants, called Huguenots, control of about 100 fortified towns for 8 years. They were also given freedom of conscience, social and political equality with the Roman Catholic majority, and a certain degree of freedom of worship. The edict was seriously enforced only until the king's death in 1610. It was eventually revoked by King Louis XIV in 1685. As a result, about 200,000 Huguenots left France.

See **Huguenots; Henry** (IV) of France.

Naomi. See **Ruth, Book of.**

Naoroji, Dadabhai (1825-1917), was a prominent early leader of the Indian nationalist movement. He was also a writer.

Naoroji was born in Bombay, where his family belonged to the small Parsee community (see **Parsees**). He was educated at Elphinstone College in Bombay. He eventually became a businessman, teacher, and journalist.

Naorji spent much of his time in England, where he became a leading advocate of Indian interests. He played a major role in establishing the Indian National Congress in 1855, and served three terms as its president. His best known book, *Poverty and Un-British Rule in India* (1901), was a collection of his essays and speeches in which he claimed that British rule had drained India of its wealth. In 1892, Naoroji became the first Indian to be elected to the British Parliament. He stood as a member of the Liberal Party. He represented Central Finsbury, in London, from 1892 to 1895.

Napalm is a powder used to thicken petrol for use in war. When napalm is added to petrol, the petrol becomes jellied. The resulting thickened petrol is also often referred to as *napalm.*

A napalm bomb dropped from the air bursts, ignites, and splatters burning napalm over a wide area. The jellied petrol clings to everything it touches, and burns violently. Napalm causes death from burns or suffocation. Napalm is also used in flame throwers that are carried by ground troops (see **Flame thrower**). Napalm was used in World War II (1939-1945), the Korean War (1950-1953), and the Vietnam War (1957-1975).

Naphtha is any liquid composed only of hydrogen and carbon atoms that boil below 200 °C. Naptha obtained during the refining of petroleum is blended to make petrol. Some types of naphtha are used to dissolve rubber and to thin paints and varnish. Others are used as a cleaning agent and as an ingredient in the manufacture of artificial gas. Naphtha can be made when coal tar, a sticky substance made from soft coal, is distilled. Coal tar naphtha is used as a dissolving agent and in the manufacture of *synthetic* (artificial) resins. Pure naphtha is highly explosive when exposed to an open flame.

Napier (pop. 52,468) is a city in the North Island of New Zealand. Napier's main exports are apples and pears, wood pulp, meat, and timber. It is also an important fishing centre. Factories in the area include woollen mills, fertilizer works, freezing works, foundries, breweries, home appliance factories, and a cigarette factory. Napier has a cathedral, an art gallery, and a museum. The main feature of the city is the Marine Parade, which extends for about 4 kilometres and is lined with Norfolk Island pines. The parade's attractions include the Marineland of New Zealand, and the country's largest aquarium.

On Feb. 3, 1931, an earthquake destroyed the inner city. The city was rebuilt rapidly, and so today, Napier has a unique concentration of buildings dating from the 1930's. The earthquake raised more than 4,000 hectares of land that had been lagoon and swamp. This additional land allowed Napier to expand.

Napier, John (1550-1617), Laird of Merchiston, was a Scottish mathematician. He developed methods of rapid calculation, which he sought to apply to astronomy, trigonometry, navigation, mapmaking, and surveying. Napier discovered how to multiply numbers by doing the easier task of adding other, corresponding numbers that he called *logarithms* (see **Logarithms**). Logarithms are used to describe mathematically many natural phenomena. Napier also invented a set of "rods" or "bones" that could be arranged for arithmetical calculations. He was born near Edinburgh, Scotland.

Naples (pop. 1,067,365) is the third largest city of Italy. Only Rome and Milan are larger. Naples lies at the foot of a range of low hills on the west coast of southern Italy. For the location of Naples, see **Italy** (political map).

Naples ranks as a major manufacturing centre, and the Bay of Naples makes it an important seaport. Tourists come from all parts of the world to see the many places of scenic and historical interest in the Naples area. The city's name in Italian is Napoli.

About 600 B.C., Greek colonists from Cumae, 23 kilometres to the west, founded a town near the site of present-day Naples. The Greeks called the town Parthenope. They later renamed it *Neapolis* (New City), and the people of Naples are still called Neapolitans. During much of the period from the 1100's until 1860, Naples was the capital of a kingdom. This kingdom included most of southern Italy and the island of Sicily. Since 1861, the city has been the capital of Campania, a political region of Italy.

The city. Naples is a city of extreme contrasts, with scenes of great beauty mixed with crowded slums. In the eastern section, church spires rise above old tenement buildings and factories. The Spacca-Napoli district, with its crowded, narrow streets, forms the heart of old Naples. The newer western part of the city lies along the Riviera di Chiaia, a broad drive that runs 5 kilometres along the Bay of Naples. A hilly, densely populated modern section called the Vomero lies inland from the bay.

The Cathedral of Saint Januarius, which was completed in 1323, honours Naples's patron saint. A number of castles in the city recall medieval times. The castles now house museum collections or government offices. The oldest of these structures, the *Castel dell'Ovo* (Castle of the Egg), takes its name from its shape. The Castel Sant'Elmo, built in the 1300's and enlarged in the 1500's, served as a prison for many years. Other interesting places in Naples are a botanical garden and a park.

Naples lies amid some of the most spectacular scenery in Europe. Artists from many countries go there to paint pictures of the landscape or the people. Mount Vesuvius, the only active volcano on the mainland of Europe, rises from a plain 11 kilometres southeast of the city. The volcano's eruption in A.D. 79 buried the ancient Roman cities of Pompeii and Herculaneum, which are within 32 kilometres of Naples. The ruins of these cities are important archaeological sites for the study of life in Roman times. The islands of Capri and Ischia, famous for their climate and scenic beauty, lie to the south across the Bay of Naples. Vineyards and citrus groves dot the hillsides on the bay's eastern shore. A few miles southwest of Naples, the town of Posillipo offers a beautiful view of the Bay of Naples. See **Capri; Herculaneum; Pompeii; Vesuvius.**

The people of Naples impress many visitors as being livelier and more carefree than those of any other Italian city. Music plays an important part in Neapolitan life. Such songs as "O Sole Mio," "Funiculi, Funicula," and "Santa Lucia" have made the city's music familiar in many parts of the world. At the Piedigrotta, an annual music festival, the people hold an outdoor competition to choose the best new popular songs. The Teatro San Carlo, one of the largest opera houses in Italy, has presented the first performance of many famous operas.

Neapolitan food includes many varieties of dishes made with spaghetti, macaroni, or noodles. Naples is the birthplace of pizza, which a baker at the royal court may have invented in the 1700's. Neapolitans also eat much fish and other seafood.

Cultural life. The National Museum in Naples displays one of the world's largest collections of ancient art objects. The collection includes glassware, mosaics, paintings, pottery, and statues from Herculaneum and Pompeii; and ancient Greek sculpture. The royal palace of Capodimonte, built in the 1700's as a residence for the kings of Naples, houses the National Gallery. The gallery owns a collection of paintings, porcelain, sculpture, and tapestries. The National Library is the largest of the city's several libraries. The library also holds thousands of rare manuscripts. The Carthusian monastery of St. Martin, which adjoins the Castel Sant'Elmo, features a museum collection devoted to the art and history of Naples. The University of Naples, the best known of the city's many schools and colleges, was founded in 1224 by Emperor Frederick II.

Economy. Products manufactured in Naples include cars, cement, chemical products, locomotives, office machinery, ships, and textiles. The highly industrialized area in and around the city has the greatest concentra-

Naples lies at the foot of low hills along the beautiful Bay of Naples. Volcanic Mount Vesuvius, *rear,* adds to the city's scenic beauty. Naples is a leading Italian port and manufacturing centre.

tion of factories in southern Italy. Ships from every part of the world use Naples' harbour. Naples still produces many traditional wares for which it became known through the years. They include kid gloves, wine, and articles made of coral and tortoise shell, such as combs and jewellery.

History. After more than a century as a Greek colony, Naples came under Roman control about 326 B.C. The city's beauty and mild climate made it a favourite resort of wealthy Romans. The poet Virgil lived in Naples for more than 20 years and is buried on a nearby hill.

After the fall of the Roman Empire in A.D. 476, various peoples fought for control of Naples and the rest of southern Italy. The Byzantines, Franks, Lombards, Normans, and Germans controlled the city for periods during the Middle Ages. Naples came under Spanish rule in 1442, and Spain held the city for most of the next 250 years.

Austria ruled Naples during the early 1700's. In 1734, the city became the capital of an independent country called the Kingdom of the Two Sicilies. A Spanish branch of the royal Bourbon family governed this kingdom (see **Bourbon**). During the Napoleonic Wars (1799-1814), Naples had a series of French rulers, including Napoleon's brother, Joseph Bonaparte. The Bourbons regained power in 1815 and ruled until 1860. In 1861, the Kingdom of the Two Sicilies became part of the newly formed kingdom of Italy. See **Sicilies, Kingdom of the Two.**

During World War II (1939-1945), bombs destroyed many buildings in central Naples and the port area. The damaged areas have been rebuilt. A housing shortage has long been a problem in Naples. Since the 1970's, the Italian government has worked to relieve the shortage. In the 1980's, it provided new housing outside the city.

Naples, Bay of, is an inlet of the Tyrrhenian Sea, an arm of the Mediterranean Sea. It is famous for the beautiful scenery along its shores, and for the deep blue colour of its waters. The Bay of Naples cuts into the southwest coast of Italy. It is about 32 kilometres wide between Cape Miseno and Point Campanella, and cuts inland about 16 kilometres. See also **Naples** (picture).

Napoleon I (1769-1821), also known as Napoleon Bonaparte, crowned himself emperor of France. He was the greatest military genius of his time and perhaps the greatest general in history. He created an empire that covered most of western and central Europe.

Napoleon was also an excellent administrator. He introduced many useful reforms, including the creation of a strong, efficient central government and the revision and organization of French laws into collections called *codes.* Many of Napoleon's reforms are evident today in the institutions of France and of areas once under French control.

Napoleon was 157 centimetres tall, about average for Frenchmen of his time, though most French generals and statesmen were taller. He earned the nickname *le Petit Caporal* (the little corporal) in 1796 at the Battle of Lodi, near Milan, Italy. In the battle, General Bonaparte startled his troops by personally aiming the cannon, a risky job usually performed by a corporal.

Napoleon was an inspirational and dramatic leader. He could also be cynical and demanding, though this side of his character was usually hidden from the public. In addition, Napoleon had great energy and ambition. He personally directed complex military manoeuvres and at the same time controlled France's press, police system, foreign policy, and domestic affairs. He chose capable subordinates and rewarded them generously with medals, wealth, military rank, and titles of nobility.

Napoleon's ambition ultimately led him to overextend his power. His downfall also resulted in part from feelings of nationalism in some of the areas invaded by French troops and from economic hardship brought on by Napoleon's attempts to exclude British goods from continental Europe. Other factors that contributed to his downfall included bitter reaction to the taxes and *conscription* (the draft) that he imposed throughout his empire, and the opposition to Napoleon of many of Europe's royal rulers.

Napoleon I posed in his study for Jacques Louis David in 1812, *above.* David served as the court painter to the French emperor.

Boyhood. Napoleon was born on Aug. 15, 1769, in Ajaccio, on the island of Corsica in the Mediterranean Sea. The year before his birth, France had bought Corsica from the Italian city-state of Genoa. Napoleon was the fourth child and second son of Carlo and Letizia Ramolino Buonaparte (later given the French spelling Bonaparte). Napoleon's parents were members of noble Italian families. Carlo Buonaparte was an eloquent lawyer and a prominent citizen of Corsica. Napoleon's mother was beautiful and strong-willed.

In 1779, at the age of 9, Napoleon entered a French military school at Brienne-le-Chateau, a town in France near Troyes. Napoleon was an average student in most subjects, but he excelled in mathematics. In 1784, he was selected for the elite military academy *École Militaire* in Paris, from which he graduated a year later.

Early military career. In January 1785, at the age of 16, Napoleon received a commission in the French Army, as a second lieutenant of artillery. He joined an artillery regiment and briefly attended the royal artillery school in Auxonne, near Dole. He was promoted to first lieutenant in 1791 and to captain in 1792.

The French Revolution broke out in 1789 (see **French Revolution**). During the early 1790's, Napoleon spent many months in Corsica on leave from the French Army. While there, he served in the Corsican National Guard. In France, however, he had joined a radical political society known as the *Jacobins.* Many Jacobins wanted to make France a democratic republic. Napoleon's membership of the society brought him into conflict with the governor of Corsica, Pasquale Paoli, who was a *royalist* (supporter of the French monarchy). After the revolutionary French government executed King Louis XVI in January 1793, Paoli declared the Bonapartes outlaws, and the family fled to France. Napoleon then returned to the French Army.

In June 1793, a group of Jacobins led by Maximilien Robespierre gained control of the French government (see **Robespierre**). Several French cities revolted against Robespierre's regime. At Toulon, the rebels were aided by a British naval fleet. When the French artillery commander at Toulon was wounded, Napoleon was sent to take his place. In December 1793, Napoleon positioned the artillery on high ground overlooking the harbour at Toulon and fired down on the British ships. The fleet withdrew and French troops gained control of Toulon. For his role in the victory, Napoleon was named brigadier general at the age of 24.

Napoleon's star had risen, but soon seemed about to set. In July 1794, Robespierre fell from power and was executed. In August, Napoleon was imprisoned for about a week. After his release, he returned to the army.

The "whiff of grapeshot." In 1795, Napoleon was in Paris when angry mobs there tried to attack the ruling National Convention at the royal palace called the Tuileries. The mobs had been encouraged by royalists who hoped to destroy the convention before it could install a new moderate government. The convention was protected by troops under Vicomte Paul de Barras. Barras had seen Napoleon in action at Toulon and now sent for him. Napoleon defended the palace with point-blank cannon fire. This cannon fire, which became known as the "whiff of grapeshot," killed or wounded hundreds of people and quickly cleared the streets. Napoleon was hailed as a hero and promoted to major general. The new government, called the Directory, was installed with Barras as one of its five directors.

Marriage. In 1796, Napoleon married Josephine de Beauharnais, a beautiful woman of French descent from Martinique in the West Indies. Josephine's first husband, Vicomte Alexandre de Beauharnais, had been sent to the guillotine during the Reign of Terror (see **French Revolution** [Terror and equality]). When Napoleon met

Detail of an oil painting on canvas (1807); the Louvre, Paris

The Coronation of Napoleon, by Jacques Louis David, shows Napoleon I crowning Josephine empress of the French. Earlier in the ceremonies, which were held in 1804, Napoleon crowned himself emperor.

her, Josephine was a leader of fashionable French society. She was six years older than Napoleon, and had two children by her previous marriage.

Rise to power

Victories in Italy. From 1792 to 1795, France had been at war with much of Europe. By 1796, Austria had become France's chief enemy. Days after marrying Josephine, Napoleon left Paris to take command of a French army on the Italian-French border—an underfed, ill-equipped force of about 38,000 men. The Directory hoped that he could tie up Austrian forces in Italy while larger French armies won the war by marching through Germany and attacking Vienna, Austria's capital.

Instead, Napoleon won the war. In less than a year, he defeated four armies, each larger than his own. He won a final victory by marching over the Alps and threatening Vienna in early 1797. In October, France and Austria signed the Treaty of Campoformio, which enlarged France's territory. Napoleon returned to Paris, where once again he was hailed as a hero.

Military strategy. Napoleon had by now developed a highly successful military strategy that was to form the basis of his future campaigns. He would start a battle while holding back as large a reserve as possible. He would then seek the weakest point in the enemy's lines and throw all his strength against that point at the decisive moment. Napoleon had an extraordinary ability to recognize the best time to attack.

Egypt invaded. When Napoleon returned to Paris after defeating Austria, he already had political ambitions. However, he felt that he did not yet have enough influence to gain control of the government. Instead, he concentrated on strengthening his military reputation. Late in 1797, the Directory offered to put Napoleon at the head of an invasion of England. But he declined the offer. Instead, he proposed that he invade Egypt to destroy British trade with the Middle East. The Directory agreed to the plan. In May 1798, Napoleon sailed for Egypt with about 38,000 men.

Napoleon reached Egypt in July. There, he defeated the Mamelukes, Egypt's military rulers, in the Battle of the Pyramids near Cairo (see **Mamelukes**). On August 1, however, the French fleet anchored in Abu Qir Bay was destroyed in the Battle of the Nile by a British fleet commanded by Lord Horatio Nelson. As a result, Napoleon's army was stranded in Egypt. Turkey then formed an alliance with Great Britain and Russia and declared war on France. In 1799, Napoleon's troops invaded Turkish Syria and advanced as far as the fortress Acre (now Akko, Israel), which Napoleon failed to capture. Meanwhile, Napoleon learned that a Turkish army was preparing to invade Egypt. He retreated to Egypt, where he met and defeated the Turks at Abu Qir, near Abu Qir Bay. About this time, Napoleon learned that Austria, Britain, and Russia had formed a coalition against France and had defeated the French army in Italy. He left his army in the command of General Jean Kléber and sailed for France.

Important dates in Napoleon's life

1769 (Aug. 15)	Born at Ajaccio, Corsica.
1796 (Mar. 9)	Married Josephine de Beauharnais.
1799 (Nov. 9)	Seized power in France.
1804 (Dec. 2)	Crowned himself emperor of the French.
1805 (Dec. 2)	Crushed the allied armies at Austerlitz.
1806 (July 12)	Set up the Confederation of the Rhine.
1806 (Oct. 14)	Defeated the Prussians at Jena and Auerstedt.
1807 (June 14)	Overwhelmed the Russians at Friedland.
1809 (July 5-6)	Defeated Austrians at Wagram.
1810 (Apr. 2)	Married Marie Louise of Austria.
1812 (Sept. 14)	Occupied Moscow.
1814 (Apr. 11)	Abdicated his throne.
1814 (May 4)	Exiled and arrived on Elba.
1815 (Mar. 20)	Returned to power in France.
1815 (June 18)	Defeated in the Battle of Waterloo.
1815 (Oct. 16)	Exiled to St. Helena.
1821 (May 5)	Died at Longwood on St. Helena.

First consul of France

News of Napoleon's victory at Abu Qir arrived with him in Paris. The French people, who had lost confidence in the Directory, cheered the return of the young hero. Napoleon formed key political alliances and seized control of the French government on Nov. 9, 1799, in a bold move known as the *Coup d'État of Eighteenth Brumaire.* A new constitution overwhelmingly approved by the French people replaced the Directory with a three-member *Consulate.* Napoleon became first consul. The other two consuls served merely as advisers to Napoleon. After 10 years of revolution and civil disorder, the French wanted a strong leader. Napoleon could now rule France as a dictator.

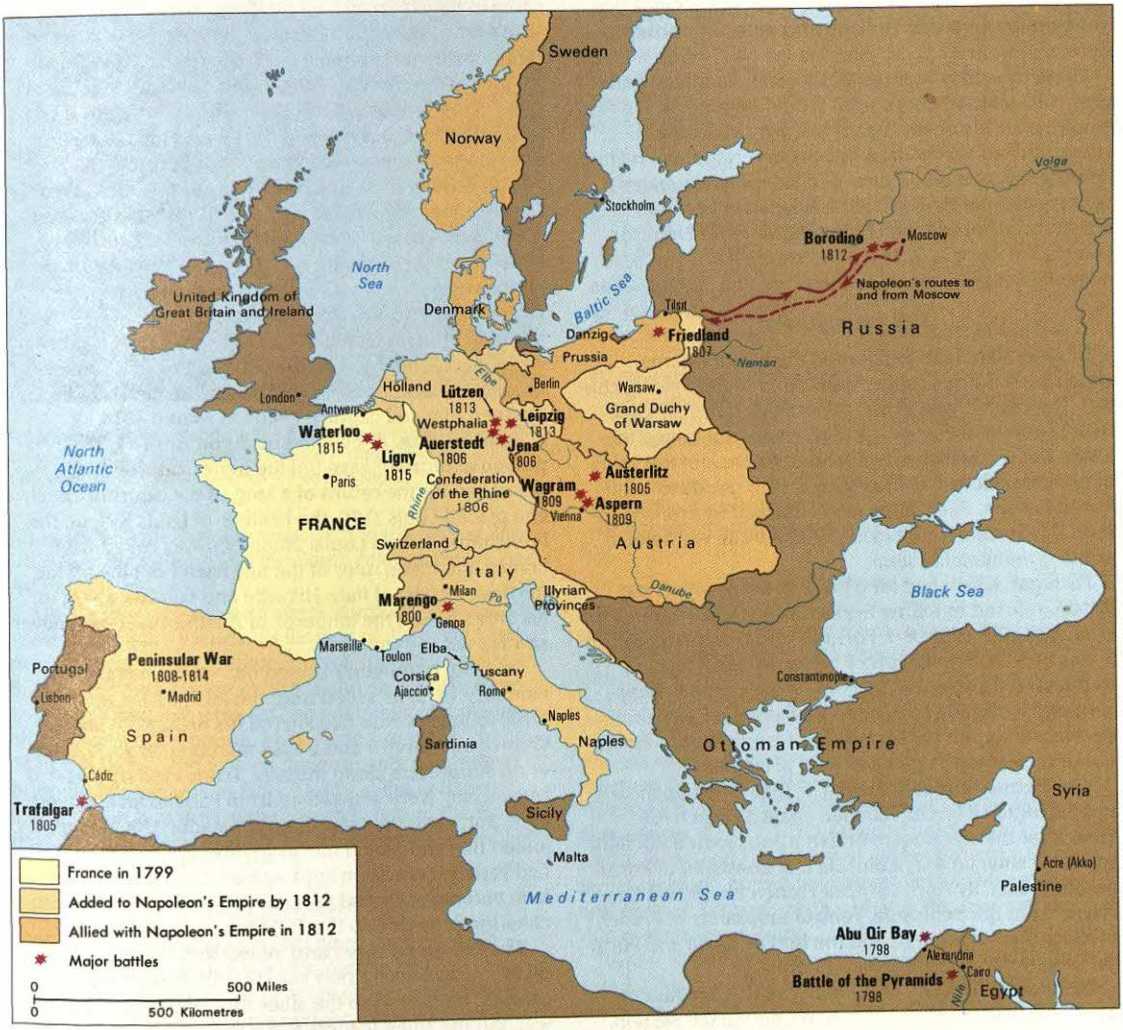
Peacemaking. As first consul, Napoleon sought peace. In May 1800, he led a famous march across the Alps, through the Great St. Bernard Pass and into the Po Valley of northern Italy. In June, his army surprised and defeated the Austrians in the Battle of Marengo. In 1801, the Austrians signed the Treaty of Lunéville, which reaffirmed the Treaty of Campoformio. With Austria defeated, the war-weary British agreed to peace in 1802 in the Treaty of Amiens. Russia had dropped out of the coalition against France in 1799. For the first time in 10 years, Europe was at peace.

Administrator and lawmaker. Napoleon proved to be a superb civil administrator. One of his greatest achievements was his supervision of the revision and collection of French law into codes. The new law codes—seven in number—incorporated some of the freedoms gained by the people of France during the French Revolution, including religious toleration and the abolition of serfdom. The most famous of the codes, the *Code Napoléon* or *Code Civil,* still forms the basis of French civil law (see **Code Napoléon**). Napoleon also centralized France's government by appointing *prefects* to administer regions called *departments,* into which France was divided.

The Napoleonic empire

French aggression. Napoleon was not content simply to govern France. His thoughts soon turned to conquest. At first, he sought to extend French influence in the Western Hemisphere. In 1800, Napoleon forced Spain to cede to France the Louisiana Territory in North America. But the army that he sent to take possession of the territory was destroyed in the French colony of Haiti by a slave revolt and by tropical disease. Frustrated, Napoleon abandoned his plans for the Western Hemisphere and turned his attention to Europe. By 1803, France had annexed the Piedmont region of northwest-

The empire of Napoleon I Napoleon became the ruler of France in 1799. By 1812, his empire covered most of Europe. Napoleon was defeated at Leipzig in 1813 and was forced to give up the French throne in 1814. He later formed another army but was defeated at Waterloo in 1815. The map shows his major battles.



ern Italy and Napoleon had become president of the Italian Republic, which bordered Piedmont on the east. Also, fearful of Britain's naval power, Napoleon had tried to stop British trade with the rest of Europe. He anticipated war with Britain and in 1803 sold the Louisiana Territory to the United States to raise money for the war. War with Britain began later that year.

Crowned emperor. In 1802, the French people had overwhelmingly approved a constitutional amendment that made Napoleon first consul for life. In May 1804, the French Senate and people voted him their emperor. Napoleon crowned himself emperor on December 2 in ceremonies at the Cathedral of Notre Dame in Paris.

Dominates Europe. By 1805, Austria, Russia, and Sweden had joined Britain in a new coalition against France. In September 1805, Napoleon led his troops into Germany. In October, he captured an Austrian army at Ulm. In December, he demolished the Austrian and Russian armies at Austerlitz. But earlier that year Lord Nelson had destroyed the fleets of France and Spain, France's ally, near Trafalgar, a cape on Spain's southern coast. This victory gave Britain control of the seas and ended any chance of Napoleon's invading Britain.

In 1806, Prussia joined Russia in mounting a new campaign against France. In October, Napoleon's forces overwhelmed the Prussian army at Jena and at nearby Auerstedt. In June 1807, Napoleon demolished Russian armies at Friedland. In 1809, he defeated the Austrians again at Wagram, near Vienna.

After each victory, Napoleon enlarged his empire. In 1806, he set up the Confederation of the Rhine, made up of a number of western German states, and placed it under his protection. Napoleon also carved provinces of Germany and Italy into principalities and dukedoms, and gave them to his friends and relatives. In 1806, he made his brother Joseph king of Naples, and his brother Louis king of Holland. In 1807, Napoleon made his brother Jerome king of Westphalia and added to France the Grand

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Duchy of Warsaw. In 1809, he gave his sister Elisa the Grand Duchy of Tuscany and annexed to France the Illyrian Provinces, which covered much of what are now Slovenia and Croatia. In 1810, he brought his empire to its height by annexing Holland and much of northern Germany.

Divorce and remarriage. By 1809, Napoleon had grown concerned about what would become of his vast empire after his death. Josephine, who was now 46 years old, had no children by him, and Napoleon had no heirs. In December, he divorced Josephine to marry a younger woman. In April 1810, he married the 18-year-old Archduchess Marie Louise, daughter of Emperor Francis I of Austria. In 1811, the couple had a son, also named Napoleon, who was given the title king of Rome.

Fall from power

In 1806, Napoleon had issued the Berlin Decree, which barred British ships from ports under French control. The decree was aimed at destroying British trade with continental Europe. In 1807, Napoleon issued the Milan Decree, which was intended to prevent the ships of neutral nations from carrying British goods to continental Europe. Such ships were attacked by French vessels. This system for blocking British trade was known as the Continental System.

Portugal, which had long been friendly with Great Britain, refused to follow the Berlin Decree. In 1807, the French gained control of Portugal and occupied parts of Spain. In 1808, French forces under Marshal Joachim Murat seized control of Madrid, Spain's capital. Napoleon removed King Ferdinand VII from the Spanish throne and appointed his brother Joseph king of Spain. Murat took Joseph's place as king of Naples.

The Peninsular War began in 1808 when Spanish and Portuguese forces rebelled against French rule. Soon after the war began, British troops joined the fight against France on the peninsula that consisted of Portugal and Spain. By April 1814, all French forces had been driven from the peninsula. Tens of thousands of French soldiers died in the war, and the loss of Spain and Portugal greatly damaged Napoleon's prestige.

Disaster in Russia. On Dec. 31, 1810, Czar Alexander I of Russia withdrew from the Continental System. Napoleon felt that the czar's withdrawal threatened France, and so he assembled a new army to attack Russia. Many years of war had weakened France, but Napoleon raised about 600,000 men. His allies and subject nations furnished by conscription many of these soldiers. The Russian army had about 200,000 men.

In June 1812, Napoleon's army crossed the Neman River into Russia. The Russians retreated, denying Napoleon a decisive battle. In September, Napoleon fought the Russians at Borodino, near Moscow. The battle resulted in many casualties on both sides, but produced no clear winner. Again, the Russians withdrew.

Napoleon pushed on to Moscow only to find the city nearly empty of people. Soon after the French army entered Moscow, large parts of the city were destroyed by fires that had been set by the retreating Russians. With the bitter Russian winter approaching, Napoleon waited in Moscow for Alexander to offer peace, but no such offer came. In mid-October, Napoleon, unable to supply his troops, began the long retreat from Moscow. His soldiers struggled against snowstorms and freezing temperatures. Soldiers and horses died of starvation and exposure. Russian soldiers called Cossacks killed many of the stragglers. Of the 600,000 men in Napoleon's army, about 500,000 died, deserted, or were captured during the campaign and the retreat from Russia.

After he returned to Paris, Napoleon admitted the disaster in his famous *29th Bulletin.* The French continued to support him, but news of the devastating campaign encouraged his enemies throughout Europe.

The enemy alliance. After his return from Moscow, Napoleon faced a hostile alliance of Austria, Great Britain, Russia, Prussia, and Sweden. In April 1813, Napoleon arrived in Germany with a new army and took the offensive against the allies. He won initial victories at Lützen, Bautzen, and Dresden, but his forces were vastly outnumbered. In October, the two sides fought at Leipzig in the Battle of the Nations. In the battle, Napoleon was defeated, and he retreated into France. The allies pursued him and captured Paris in March 1814.

Exile to Elba. At Fontainebleau on April 11, 1814, Napoleon *abdicated* (gave up) the imperial throne. The allies called for the return of a king of the Bourbon family and placed Louis XVIII, the brother of Louis XVI, on the French throne (see **Louis**). Napoleon was exiled from France and made ruler of the tiny island of Elba off the northwest coast of Italy. His wife and son were sent to his wife's father, the emperor of Austria. Napoleon never saw his wife or son again.

On Elba, Napoleon planned his return to France. In February 1815, he sailed from the island with about 1,100 followers who had shared his exile. He landed at Cannes on March 1 and began marching to Paris, gathering supporters along the way. Troops led by Marshal Michel Ney were dispatched from Paris to arrest Napoleon. But when they saw their old leader, the men gladly joined him and hailed him as their emperor. Louis XVIII fled Paris as Napoleon approached. On March 20, Napoleon entered Paris and was carried on the shoulders of cheering crowds into the Tuileries.

The Hundred Days and Waterloo. Napoleon immediately proclaimed a new constitution that limited his powers. He promised the allies that he would not make war. But the allied leaders considered Napoleon an "enemy and disturber of the peace of the world." Once again, both sides prepared for battle.

Napoleon advanced into Belgium with about 125,000 men, hoping to defeat the separate armies of Britain's Duke of Wellington and the Prussian Marshal Gebhard von Blücher. On June 16, Napoleon defeated Blücher at Ligny, near Fleurus. On June 18, Napoleon attacked Wellington at Waterloo in what has become one of history's most famous battles. The battle featured spectacular charges by thousands of French cavalry. But just as it seemed the British forces would collapse, Blücher's troops arrived to reinforce Wellington. Badly outnumbered, the French army suffered a crushing defeat.

Napoleon fled to Paris and abdicated for the second time, on June 22. The period from Napoleon's return to Paris from Elba to his second abdication is known as *the Hundred Days.*

Napoleon tried to escape to the United States, but he failed and surrendered at Rochefort to Frederick Lewis Maitland, the captain of the British battleship *Bellero-*

Napoleon's Tomb stands in the *Église du Dôme* (Church of the Dome) in Paris. The remains of France's "Little Corporal" are in this tomb, which stands almost 4.5 metres high.

phon. In August, Napoleon was sent to the barren British island of St. Helena, in the South Atlantic Ocean (see **Atlantic Ocean** [map]).

On St. Helena, Napoleon spent much of his remaining years dictating to friends his version of the events that occurred during his lifetime. He died of cancer on May 5, 1821, and was buried on the island. In his will, Napoleon had asked to be buried "on the banks of the Seine, among the French people I have loved so much." In 1840, the British and French governments cooperated in bringing his remains to Paris. There, at the Église du Dôme (Church of the Dome), which is part of the Hôtel des Invalides (Home for Disabled Soldiers), the body of Napoleon was laid to rest.

Napoleon's place in history

Napoleon is both a historical figure and a legend—and it is sometimes difficult to separate the two. The events of his life have fired the imaginations of great writers, filmmakers, and playwrights whose works have done much to create the Napoleonic legend.

Napoleon was one of the greatest military commanders in history. But he has also been portrayed as a power-hungry conqueror. Napoleon denied being such a conqueror. He argued that, instead, he had attempted to build a federation of free peoples in a Europe united under a liberal government. But if this was his goal, there is no doubt that he intended to achieve it by concentrating power in his own hands. However, in the states he created, Napoleon granted constitutions, introduced law codes, abolished feudalism, created efficient governments, and fostered education, science, literature, and the arts.

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Outline

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Questions

What was the *"whiff of grapeshot"*?
How did Napoleon centralize the government of France?
Why did Napoleon retreat from Moscow in 1812?
What were the *Hundred Days*?
Why did Napoleon divorce Josephine and remarry?
What strategy formed the basis of Napoleon's military campaigns?
Why did Napoleon invade Egypt?
What was the *Continental System*? *The Consulate*?
Why was the Louisiana Territory sold to the United States?

Napoleon II (1811-1832), Duke of Reichstadt, was the son of Napoleon I and Marie Louise of Austria. Napoleon I had long hoped for a son to inherit his empire, and greeted his son's birth with joy. He gave him the title of the king of Rome.

When Napoleon I was overthrown in 1814, he abdicated in favour of his young son. The senate did not recognize the title, and called Louis XVIII to the throne. Marie Louise took her son to live at the court of her father, Francis I of Austria. When Napoleon I was defeated at Waterloo in 1815, he proclaimed his son Napoleon II. However, the French again ignored him and Napoleon II remained in Austria. His mother's family gave him the title of Duke of Reichstadt in 1818.

He was never strong, and grew into a tall, slender youth. He died of tuberculosis at the age of 21 and was buried in the Habsburg (or Hapsburg) family's church tomb in Vienna. The French government later requested that his body be returned to France, but the request was refused for many years. In 1940, Adolf Hitler had the body placed near that of Napoleon I in the *Église du Dôme* (Church of the Dome) in Paris. Napoleon II was born in Paris. Edmond Rostand based a play, *L'Aiglon* (The Eaglet), on his life.

Napoleon III (1808-1873) ruled as Emperor of France from 1852 to 1870, and was closely associated with major European political changes.

Early life. He was born in Paris, the son of Louis Bonaparte, king of Holland and brother of French Emperor Napoleon I. His full name was Charles Louis Napoleon Bonaparte, but he was usually called Louis Napoleon. A French law of 1816 exiled the Bonapartes from France, and Louis Napoleon spent his youth in Italy, Germany, and Switzerland. He was connected with such revolutionary groups as the *Carbonari* in Italy. He tried to overthrow the French monarchy of Louis Philippe in 1836 and again in 1840. He was imprisoned in a French fortress following the 1840 attempt. He escaped to England in 1846. During these years, he wrote his *Napoleonic Ideas* (1839), idealizing the career of his famous uncle, and *The Extinction of Poverty* (1844), proposing that the government act to end poverty and suffering.

Becomes emperor. When the Revolution of 1848 led to the Second Republic in France, Louis Napoleon returned and was elected to the Assembly. In December, he was elected president. He swore an oath to the republic, but in December 1851, he managed to concentrate all power in his hands. He abolished the republic and proclaimed himself emperor in 1852.

Napoleon's domestic policies were conflicting. He ruled as a dictator and was surrounded by dishonest adventurers. Although all men could vote, the legislature was powerless and the press could not publish legislative debates. When, after 1860, Napoleon moved in the direction of a liberal empire, it was too late. Liberal opponents continued to urge the overthrow of his government. Yet Napoleon keenly realized the problems of the industrial age. He favoured state help for industries, banks, railways, and the poor.

Foreign affairs. Napoleon tried to settle disputes through international conferences, and he sympathized with claims of nationalism. For example, he helped win independence for Romania and unification for Italy.

Napoleon announced when he became emperor, "The Empire means peace," yet he led France into a long series of campaigns in other countries. In 1849, he helped overthrow the Roman Republic and restore the pope. He joined England and Turkey in 1854 in the Crimean War against Russia. He supported a scheme making Maximilian, the archduke of Austria, emperor of Mexico in 1864. But United States pressure in 1867 forced him to withdraw his troops and leave Maximilian to be shot.

His defeat. In the Franco-Prussian War of 1870, the Germans easily defeated the French. Napoleon surrendered to the Germans at Sedan, France, on Sept. 2, 1870, with 80,000 troops. Two days later, supporters of a new French republic overthrew Napoleon's empire.

See also **Franco-Prussian War; Eugénie Marie de Montijo; Maximilian.**

Napoleonic Code. See **Code Napoléon.**

Naracoorte Caves are a series of 60 limestone caves about 390 kilometres southeast of Adelaide, Australia. Sixteen of the caves are in the Naracoorte Caves Conservation Park, administered by the National Parks and Wildlife Service. Three caves are open to the public.

Blanche Cave was discovered in 1845. Benjamin Sanders, a station manager, found the cave while searching for some lost sheep.

The Alexander Cave, 160 metres in length, was discovered in 1902. It is a *live cave,* which means that stalagmites and stalactites are still forming. This cave contains many formations, such as the *wedding cake* and the *fairy castle.* It also contains marine fossils and bone material of wombats, kangaroos, and possums.

The Victoria Cave, 183 metres in length, was discovered in 1894. It includes a series of chambers, connected by narrow, excavated walkways. One chamber, called *fossil cave,* contains many animal remains, including the bones of two extinct marsupials.

Narasimhavarman I (630?-668?), also known as *Mamalla,* was king of the Pallava dynasty of southern India. He is chiefly remembered for developing the town of Mahabalipuram, formerly called Mamallapuram in his honour. The town lies on the Bay of Bengal in what is now the Indian state of Tamil Nadu. It was already a thriving commercial port when Narasimhavarman took it over, but he enlarged it and turned it into a naval base and Hindu religious centre. Its surviving temples and monuments fascinate tourists and scholars. Narasimhavarman is portrayed on one of the rock carvings, inscribed with the title "Augmenter of the Three Worlds".

Narasimhavarman was a notable warrior. He killed King Pulakeshin II, ruler of the neighbouring Chalukyas dynasty, and destroyed his capital, Vatapi. He also sent two naval expeditions to Sri Lanka to support Manavamma, a Sinhalese prince who coveted the throne.

Narayan, R. K. (1906-   ) is an Indian novelist and short-story writer who writes in English. His novels show how the lives of ordinary Indian people reflect the greater concerns of national identity and historical change. Critics have praised Narayan for the tragi-comic quality in his work and the gentle irony with which he treats his characters.

Rasipuram Krishnaswami Narayan was born in Madras. He was educated at the Collegiate High School in Mysore, where his father was headmaster, and at Maharaja's College, Mysore. Narayan worked as a teacher and journalist before publishing his first novel, *Swami and Friends* (1935). The novel explores the concerns of people living in the imaginary village of Malgudi. Malgudi is also the setting for many of Narayan's subsequent novels, which include *The English Teacher* (1958), *Waiting for the Mahatma* (1958), and *The Talkative Man* (1986). Many of his short stories are collected in *Under the Banyan Tree and Other Stories* (1958) and *Grandmother's Tale and Other Stories* (1993).

Narcissus, in Greek mythology, was a handsome youth who was courted by many lovers for his beauty. He, however, haughtily rejected all of them, including the nymph Echo. As punishment for his cruelty, the gods condemned Narcissus to contemplate his beauty reflected in a pond on Mount Helicon in Greece. Day after day he lay beside the pond, gazing lovingly at his reflection until he wasted away and died. When searchers went out to look for him, they found only a flower, now called the narcissus. Echo also wasted away from her love for Narcissus, finally becoming nothing more than a voice in the woods. The best-known version of the Narcissus story appears in the *Metamorphoses,* a collection of tales by the Roman poet Ovid.

Narcissus is the name of a large group of early spring flowers with lovely blossoms. They grow from brown-coated bulbs. They were named after the legendary Greek youth Narcissus. Narcissuses are native to Europe and Asia. They have fragrant and delicately fashioned

The poet's narcissus has a single, wide-open blossom on each stalk. The blossom has a yellowish cup and white petals.

blossoms of yellow, white, or sometimes pink. In Europe, in the springtime, fragrant masses of wild narcissuses cover the Alpine meadows. Narcissus bulbs are poisonous.

There are various types of narcissuses. All of them send up shoots with sword-shaped leaves. The flowers have six petals surrounding a trumpet- or cup-shaped tube, which may be long or short. Many botanists consider *daffodils* to be long-trumpet narcissuses. *Jonquils* are short-trumpet narcissuses. Another short-trumpet species is the *poet's narcissus.*

The *paperwhite narcissus* is a short-trumpet species that can be grown indoors in winter from bulbs placed on pebbles.

Scientific classification. Narcissuses belong to the amaryllis family, Amaryllidaceae. The daffodil is *Narcissus pseudonarcissus.* The poet's narcissus is *N. poeticus;* the paperwhite is *N. tazetta.*

See also **Bulb; Daffodil; Jonquil.**

Narcolepsy is a disease that causes excessive sleepiness. People with narcolepsy tend to fall asleep several times a day, even though they get enough sleep at night. The cause of the disease is unknown, but much evidence indicates that it is hereditary. Doctors can help ease the problem with drugs, but narcolepsy cannot be cured.

Narcolepsy has several symptoms in addition to excessive sleepiness. For example, narcoleptics may experience *episodes* (attacks) in which they are awake but cannot move. This condition is called *cataplexy.* Most episodes are brought on by strong emotions, especially anger or laughter, and last two minutes or less. A person with narcolepsy may also experience *sleep paralysis* and *hypnagogic hallucinations.* In sleep paralysis, the person suddenly becomes unable to move just as he or she is falling asleep. Hypnagogic hallucinations are vivid, realistic dreams that occur at the start of sleep.

Scientists believe the symptoms of narcolepsy are related to *REM* (*R*apid *E*ye *M*ovement) *sleep,* the phase of sleep during which people dream. The eyes move rapidly during this phase, and the body is paralysed while dreaming occurs. Narcoleptics experience this same sort of paralysis—while awake—during a cataplectic episode. In addition, narcoleptics tend to have REM sleep at abnormal times, especially at the very beginning of sleep. In these cases, the REM dreams may be experienced as hypnagogic hallucinations.

Not all people who are abnormally sleepy have narcolepsy. But if they also experience cataplexy, they are almost certain to have narcolepsy.

See also **Cataplexy; Amphetamine** (Medical uses).

Narcotic is a substance that has a strong depressant effect upon the human nervous system. Narcotic substances cause insensibility to pain, stupor, sleep, or coma, according to the amount taken. The term *narcotic* comes from a Greek word meaning *to make numb.*

Narcotics include opium, codeine, morphine, and heroin. When a narcotic is given in doses large enough to cause sleep or coma, the drug is called a *hypnotic.* The term *anodyne* is applied to a drug that relieves pain by numbing the nerves. Therefore, a narcotic may be both an anodyne and a hypnotic.

Narcotics produce an analgesic effect by interacting with specific nerve cells called *receptors* in the central nervous system. Several chemicals that occur naturallly in the body, including *endorphins* and *enkephalins,* interact with the same receptors. Scientists believe these naturally occurring chemicals control the brain's perception of pain. See **Endorphin.**

Narcotic drugs are extremely useful in medicine, but they also have dangerous effects. Large doses of narcotics may cause death. The careless use of opium and substances made from it to relieve pain has often caused a drug habit. No one should use these drugs except under the direction of a doctor. Most countries carefully regulate the importation of narcotics as well as the manufacture and distribution of narcotic by-products.

Related articles in ***World Book*** include:

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Heroin
Morphine
Opium

Nard. See **Spikenard.**

Narváez, Pánfilo de (1478?-1528), was a Spanish soldier, explorer, and Indian fighter. He helped conquer Cuba in 1511, and lost an eye trying to arrest Hernando Cortés in Mexico in 1521. Holy Roman Emperor Charles V granted him the unexplored land of Florida in 1526, and he led an expedition there in 1528.

He marched inland, and lost many of his men in storms and Indian attacks. While exploring, he was cut off from his ships, and they returned without him. Attacked by Indians, he and his men built five crude barges. They sailed along the coast to what is now south Texas. Narváez's boat was forced out into the Gulf of Mexico by winds and currents, and he was drowned. He was born in Valladolid.

Narwhal is an unusual whale of the Arctic. The male has a spiral ivory tusk about 2.5 metres long jutting out of the left side of its head. The tusk is really the narwhal's only tooth. A few narwhals, mostly females, have two tusks. The female usually has no tusk. Young narwhals use their tusks in play-fighting. So far as is known, the adult makes no use of its tusk. However, the tusks of most adult narwhals are worn at the tip. Perhaps the animal stirs up sand or mud with its tusk while feeding.

Narwhals grow about 5 metres long, not including the tusk, and weigh up to about 2 metric tons. They are grey-white, and have dark-grey or black spots. Inuit of Greenland hunt narwhals. They eat the skin, which they call *muktuk,* and use the ivory to make tools.

Scientific classification. The narwhal belongs to the whale order, Cetacea. It is *Monodon monoceros.*

NASA. See National Aeronautics and Space Administration.

Nash, Beau (1674-1762), was a celebrated English dandy, known for his magnificent clothes and elegant manners. In 1704, he became master of ceremonies at Bath. Many of Bath's fine buildings and streets, and its success as a resort, are due to his influence. Nash was born in Swansea and named Richard Nash. He studied at Oxford University and later studied law at the Temple, in London. He became an army officer and a gambler.

Nash, Charles William (1864-1948), was a pioneer in the United States motorcar industry. He became president of the Buick Motor Company in 1910, reorganized the company, and made it financially successful. Nash was elected president of General Motors Company (now General Motors Corporation) in 1912 when it was close to bankruptcy. General Motors also prospered under Nash's leadership.

Nash resigned from General Motors in 1916. He then bought a car firm from which he formed Nash Motors Company. He was president of the company until 1932, and chairman until he died. The Nash firm merged with Hudson Motors in 1954, and became American Motors. Nash was born in De Kalb County, Illinois.

Nash, James (1834-1913), a prospector, discovered the goldfields at Gympie, Queensland, Australia, in 1867. His report of the find started one of the greatest gold rushes in Queensland's history. The reef that Nash found produced gold worth millions of Australian dollars. But Nash received only a small reward. He also made some money from the gold he obtained from his claim but lost it later when he opened a shop. In 1888, the Queensland government gave him a job as keeper of the powder magazine at Gympie. A memorial fountain incorporating a 7-metric ton block of granite was later erected in his honour in Gympie Park.

Nash was born in Wiltshire, England. He went to Australia in 1857.

Nash, John (1752-1835), was an English architect and landscape gardener. Under the patronage of the Prince of Wales, later George IV, he replanned the Regent's Park area of London as a vast landscaped garden. This garden was to be broken up by wide streets bordered on each side by villas. Regent Street, Waterloo Place, and Carlton House Terrace were completed between 1810 and 1830. But the remainder of his design was abandoned because of the cost. Nash was born in London. He worked on a number of other projects, including Buckingham House (now Buckingham Palace), the Marble Arch, and Brighton Pavilion.

John Nash designed Chester Terrace in London's Regent Park in 1825 as part of a scheme for the area.

Nash, Ogden (1902-1971), was a famous American writer of humorous and satirical poetry. He created a unique poetic style in his light-hearted verses.

Most of Nash's poems have lines of unequal length. He often stretched sentences over several lines to produce surprising and comical rhymes. In "The Terrible People," for example, Nash wrote:

> People who have what they want are very
> fond of telling people who haven't what
> they want that they really don't want it,
> And I wish I could afford to gather all
> such people into a gloomy castle on
> the Danube and hire half a dozen
> capable Draculas to haunt it.

Nash also used many puns and frequently made clever comparisons of apparently unrelated subjects. He sometimes invented words or misspelled real words to produce a carefully planned effect.

Although Nash wrote in a comic style, many of his poems make a serious point. He made satirical comments about American society and ridiculed what he considered foolish behaviour, including his own. Nash described people as bewildered by all the complications of modern life. He regarded humour as the best means of surviving in a difficult world.

The first collection of Nash's verses, *Hard Lines,* was published in 1931. His other collections include *Many Long Years Ago* (1945) and *You Can't Get There From Here* (1957). *The Old Dog Barks Backwards* (1972) and *I Wouldn't Have Missed It*

Ogden Nash

(1975) appeared after his death. Nash was born in Rye, New York. Many of Nash's poems were first published in *The New Yorker* magazine.

Nash, Paul (1889-1946), was an English painter known for his landscapes and battle scenes. As an official war artist in World Wars I and II, he painted such pictures as the *Menin Road* (1918) and a series on the Battle of Britain. Nash's work is characterized by a delicate sense of colour and an uncomplicated style. Nash was born in London and educated at St. Paul's School and the Slade School. He taught at the Royal College of Art and experimented with abstract and surrealist painting.

Nash, Thomas (1567-1601?), was an English writer of the Elizabethan period whose works reflect his rowdy nature. He was involved in many disputes, and attacked his opponents in skilfully written pamphlets. Nash is probably best known today for *The Unfortunate Traveller; or, The Life of Jack Wilton* (1594), an example of Elizabethan prose fiction at its best. This book's narrative structure, realistic detail, and references to actual events and persons make it an important forerunner of the modern novel.

Nash was born in Lowestoft, Suffolk. He studied at Cambridge University, and belonged to a group of popular writers often called the *University Wits.* In 1589, Nash joined in the "Martin Marprelate" controversy between the Puritans and the Church of England. He wrote several pamphlets that attacked the Puritans. Nash and the poet Gabriel Harvey carried on a bitter feud through pamphlets. One of Nash's attacks is contained in *Pierce Penniless* (1592), which also satirizes Elizabethan society.

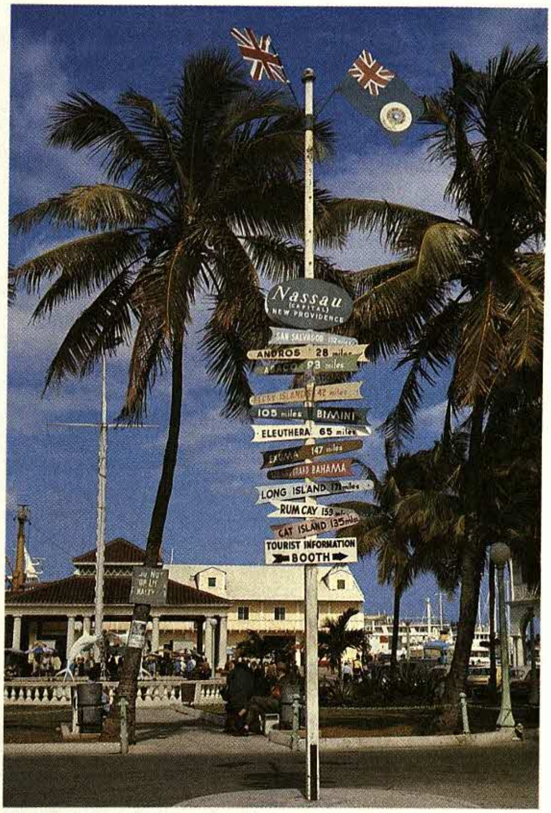
Nashville (pop. 510,784; met. area pop. 985,026) is the capital and second largest city of Tennessee, U.S.A. Nashville is often called the *Athens of the South* because of its many educational institutions and its buildings in the Greek classical style. Nashville is also called *Music City, U.S.A.* because it has become a centre for country music. More than 180 recording companies, 23 recording studios, and about 450 song-publishing firms operate in the city.

Nasmyth, James (1808-1890), a Scottish engineer, invented the steam hammer. He also developed the *self-acting principle* in machine-tool design, by which a mechanical hand moving along a slide holds a tool. Using this principle, Nasmyth invented a planing mill and a nut-shaping machine.

Nasmyth was born in Edinburgh, the son of a noted artist. In 1829, he became assistant to Henry Maudslay, a tool designer and manufacturer. In 1834, Nasmyth started the Bridgewater Foundry at Manchester, which became famous for machine-tool and steam-engine construction. Nasmyth invented the steam hammer in 1839. He retired in 1856 and devoted his time to studying astronomy.

Nassau (pop. 135,437) is the capital and largest city of the Bahamas. It borders an excellent harbour on the northeast coast of New Providence Island. For location, see **Bahamas** (map). The city's warm, sunny climate has made it a major tourist centre.

Near Nassau's harbour are beautiful beaches and luxurious hotels. Nassau also features fine restaurants, colourful markets, and gambling casinos. Most of the city's major banks, shops, and government buildings are located on Bay Street, which runs along the harbour. Nassau has a number of historic buildings, including three forts built in the 1700's. The nation's only college, the College of the Bahamas, is in Nassau.



Rawson Square is one of Nassau's popular sites for leisure and for business. It attracts a busy tourist trade.

Many of Nassau's people work in the tourist industry and are prosperous. But the city has few manufacturing industries, and unemployment is high. Some Nassau residents live in charming, pastel-coloured houses. In the poorer neighbourhoods, people live in run-down houses, some of which have no running water.

Nassau's busy harbour serves as a port for cruise ships that carry tourists to the city. Smaller ships called *mailboats* transport freight and passengers between Nassau and the many islands that—along with New Providence—make up the Bahamas. Such products as fish, oil, rum, and salt are shipped through Nassau.

English seafarers founded a settlement named Charles Towne at what is now Nassau in the 1660's. The settlement was renamed Nassau in 1695. The Bahamas became a British colony in 1717, with Nassau as the capital. Nassau became prosperous during the American Civil War (1861-1865), when ships carried goods from the city to the Confederate States. It also prospered during the U.S. Prohibition Era (1920-1933) as a distribution centre for the illegal shipment of alcoholic beverages into the United States. Tourism has been Nassau's principal industry since 1929. In 1973, the Bahamas gained independence from Great Britain.

See also **Bahamas** (picture).

Nasser, Gamal Abdel (1918-1970), an Egyptian army officer, led the revolt that overthrew King Faruk in 1952 and established Egypt as a republic. He served as prime minister from 1954 until he was elected president of Egypt in 1956. Later that year, a world crisis occurred after Egypt seized the Suez Canal, then under international control. Nasser wanted to use the tolls collected from users of the canal to build the Aswan High Dam. When Syria and Egypt formed the United Arab Republic (U.A.R.) in 1958, Nasser became its president. Syria withdrew from the U.A.R. in 1961.

Nasser resigned after Egypt lost the six-day Arab-Israeli War of 1967. But the Egyptian National Assembly refused to accept his resignation, and massive demonstrations of public support led him to stay in office. He became both president and prime minister of Egypt. Fighting between Israel and the Arab nations continued into the 1970's. Nasser relied heavily on Soviet military aid. In August 1970, he agreed to a 90-day ceasefire with Israel. His sudden death in September 1970 threatened the chances for a lasting peace.

Nasser's book, *Egypt's Liberation: The Philosophy of the Revolution* (1955), stated his aim to unite all Arabs under Egyptian leadership. Although his efforts toward this goal failed, he became one of the most influential men in the Arab world. Nasser claimed to follow a neutral foreign policy. His guiding principles were nationalism and economic reform. Nasser redistributed land to farmers and also advanced education.

Born in Alexandria, Nasser graduated from the Royal Military Academy in Cairo. He fought in the Arab war against Israel in 1948 and 1949.

See also **Egypt** (Republic).

Nasser, Lake. See **Lake Nasser.**

Nast, Thomas (1840-1902), was an American political cartoonist. He popularized the famous political symbols of the Democratic donkey, and originated the Republican elephant and the Tammany Tiger (see pictures with **Democratic Party; Republican Party**). His caricatures of the Tammany Tiger helped break up the notorious political organization headed by William "Boss" Tweed in New York City.

Nast's cartoons began appearing in the popular magazine *Harper's Weekly* during the 1860's. He did his best work during the American Civil War, when his political cartoons influenced public opinion in favour of the North. In the presidential campaign of 1872, Nast's barbed cartoons helped bring about the defeat of Horace Greeley. Nast is also credited with creating the present-day image of Santa Claus in sketches that appeared in *Harper's Weekly* in the 1860's.

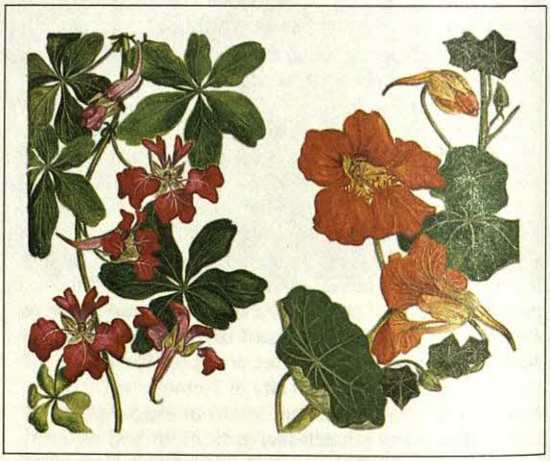
Nast was only an average draughtsman. But he excelled at inventing concepts for cartoons and at arranging the elements of his designs. In most cases, Nast drew sketches that were given to other artists, who used the sketches to make engravings in blocks of wood. The engravings were used to print the cartoons.

Nast was born in Landau, Bavaria, and moved with his mother to the United States in 1846. He worked as a draughtsman on *Frank Leslie's Illustrated Newspaper* and sketched warfare in Italy for New York, London, and Paris newspapers.

Nasturtium is the common name of a group of perennial plants native to tropical America. Nasturtium is a favourite garden flower. It is a trailing or climbing annual that may reach about 3 metres tall. Its blossoms are yellow, orange, or red. Dwarf nasturtiums are also grown.

The nasturtium flower has an interesting structure. There are five small *sepals* (outer "petals"). The three upper ones form a long spur that holds the nectar. There are also five petals. The three lower petals are a little apart from the upper two and have long, fringed claws. The long-stalked leaves are shaped like an umbrella. They have a spicy taste and are used in salads. The leaves also make an attractive light green background for the bright flowers.

Nasturtiums grow well from seeds sown outdoors in spring. They can also be potted in the early spring and transplanted in May. The plants cannot stand frost, but may be grown indoors in winter. Nasturtiums are easy to grow. They thrive best in bright sunlight. Small insects, called black aphids, often attack the plants and live on the underside of the leaves. The insects will destroy the nasturtium unless they are controlled with insecticide. The name *nasturtium* is also given to the genus of the water cress (see **Cress**).



The nasturtium is a North American garden plant. Its blossoms are orange, red, or yellow. It has umbrella-shaped leaves.

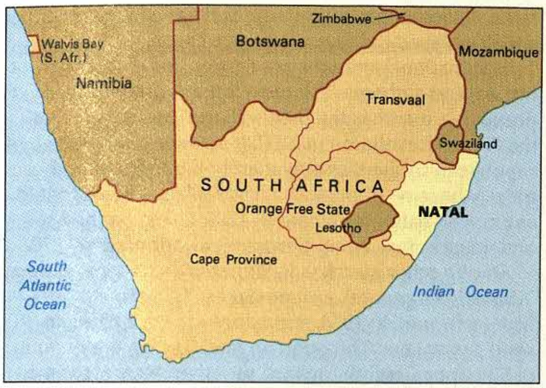
Scientific classification. Nasturtiums belong to the nasturtium family, Tropaeolaceae. The garden flower is *Tropaeolum majus.*

Natal was a province in South Africa from 1910 to 1994. It lay on South Africa's east coast, bordering the Indian Ocean.

Natal was home to Khoisan hunter-gatherers when the first Iron Age people moved into the region in the A.D. 400's. In about 1000, a new group of immigrants, possibly Nguni-speakers, also moved into the area.

The Portuguese explorer, Vasco da Gama, sailed past Natal in December 1497. He gave the region its modern name *Terra do Natal* (Land of Christ's birth). There was no further European interest in Natal until the 1800's.

During the 1820's, the Zulu king Shaka scattered the Nguni people of Natal to create a zone between the Zulu empire and the southern Nguni. The first Europeans, a group of traders, arrived at Shaka's royal court in 1824 and were given land at Port Natal (now Durban). A

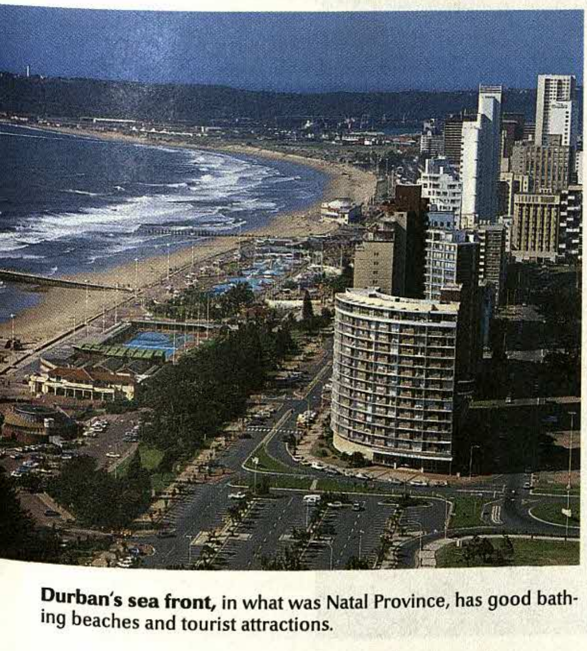


Natal, once a province of South Africa, lies along the Indian Ocean. Its coast has many sandy beaches.

small European settlement developed there. In 1838, *Voortrekkers* (forerunners) of mainly Dutch descent, also known as *Boers,* defeated the Zulu army at the battle of Blood River. After reaching an agreement with the Zulu king, Mpande, the trekkers established the Republic of Natalia.

The government of the United Kingdom (UK) opposed the establishment of the new Boer republic. British troops defeated the trekkers in July 1842 after a short struggle. The UK annexed Natal in 1843. Natal became a province of the UK's nearby Cape Colony in 1844. Most of the trekkers left Natal. The UK introduced immigration schemes to attract settlers from the UK and Ireland, and organized the Zulu and Nguni peoples into special settlement areas under the control of the governor.

Between 1860 and 1911, the government tried to ease a labour shortage in Natal by bringing labourers from India. Other Indians came independently to set up businesses to serve Indians already living in Natal.



Durban's sea front, in what was Natal Province, has good bathing beaches and tourist attractions.

In the 1870's, the Zulu leader Cetshwayo reestablished the Zulu as a strong military force in southern Africa. In January 1879, British and colonial forces invaded Zululand. The British suffered heavy losses but eventually defeated Cetshwayo's army at the Battle of Ulundi in July 1879.

During the Anglo-Boer War (1899-1902), Natal was invaded by Boers. Natal became a self-governing province in the new Union of South Africa in 1910.

In 1994, South Africa adopted a new constitution which replaced the four provinces created in 1910 with nine new provinces. Natal was incorporated into the province of Kwazulu-Natal.

See **Kwazulu-Natal.**

Nathanael. See **Bartholomew, Saint.**

Nation is a large group of people united by a common language, ancestry, history, or culture. People often feel great loyalty to their nation and pride in their national characteristics. Such feelings of loyalty and pride are often referred to as *nationalism.* See **Nationalism.**

In international law, *nation* means a group of people exercising self-government within a defined territory with the *recognition* of other nations. Recognition is shown by other nations through the exchange of ambassadors. When a new nation is recognized by other nations, it acquires certain rights and duties. Its rights include the right to navigate freely on the high seas. Its duties include the obligation not to threaten or use military force against other nations. Sometimes in international law, a nation is called a *country* or *state.* For more information on nations as defined in international law, see **Country; International law.**

Nation, Carry Amelia Moore (1846-1911), became well known for her violent efforts to stop the sale of alcohol in the United States from the 1880's up to her death. Although she was arrested often for disturbing the peace, she impressed many people with her sincerity and courage. Other people considered her intolerant. She carried the temperance crusade from the level of education to that of action, and helped bring on national prohibition in 1919 (see **Prohibition**).

She was born on Nov. 25, 1846, in Garrard County, Kentucky, U.S.A. In 1867, she married Charles Gloyd, a drunkard who died soon after their marriage. She then became a schoolteacher and rented rooms. In 1877, she married David Nation, a lawyer and minister. Her strong religious interests intensified, and she began to see visions. Her belief that she was divinely protected increased in 1889, when a fire in her town left her hotel untouched. She thought, too, that her name (Carry A. Nation) had been preordained.

The Nations settled in Kansas in 1889. An 1880 state law banned sales of alcohol there. But it was not enforced. Carry Nation began in 1890 to pray outside saloons. Later she began to smash them. She closed the saloons of her own town, Medicine Lodge, and destroyed saloons in the chief Kansas cities. When she entered states where sales of alcohol were legal, she was often arrested for disturbing the peace. Carry Nation opposed tobacco, and immodesty in women's dress. She spoke eloquently, and won many followers. Her husband divorced her for desertion in 1901.

Nation of Islam. See **Black Muslims.**

National Aeronautics and Space Administration (NASA) is a United States government agency that conducts and coordinates research of flight within and beyond the earth's atmosphere. NASA employs about 21,000 scientists, engineers, and technicians in 10 major installations. These facilities include the John F. Kennedy Space Center, the Lyndon B. Johnson Space Center, Goddard Space Flight Center, and George C. Marshall Space Flight Center.

NASA was established in 1958 as an independent agency. It absorbed the National Advisory Committee for Aeronautics. NASA has launched numerous unmanned and manned space flights. The unmanned flights included various kinds of artificial satellites and space probes. NASA accomplished a major goal in 1969, when its *Apollo* spacecraft became the first to land human beings on the moon. In 1973, NASA launched the first U.S. manned space laboratory into orbit around the earth. In 1981, it sent out the first manned space shuttle, a reusable space vehicle.

In 1986, NASA suffered the worst accident in its history. The space shuttle *Challenger* exploded shortly after launching on January 28. All seven crew members were killed, including Christa McAuliffe, a New Hampshire teacher. Soon afterward, NASA halted shuttle flights while it worked to improve shuttle safety and resolve management problems. Manned space flight resumed in September 1988, with the launch of the redesigned space shuttle *Discovery*.

See also **Space exploration.**

National anthem is the official patriotic song of a nation. National anthems are intended to stir a sense of patriotism and loyalty among citizens of a country. They are performed at official and ceremonial public occasions, international gatherings, and athletic events. They are also played to honour a head of state.

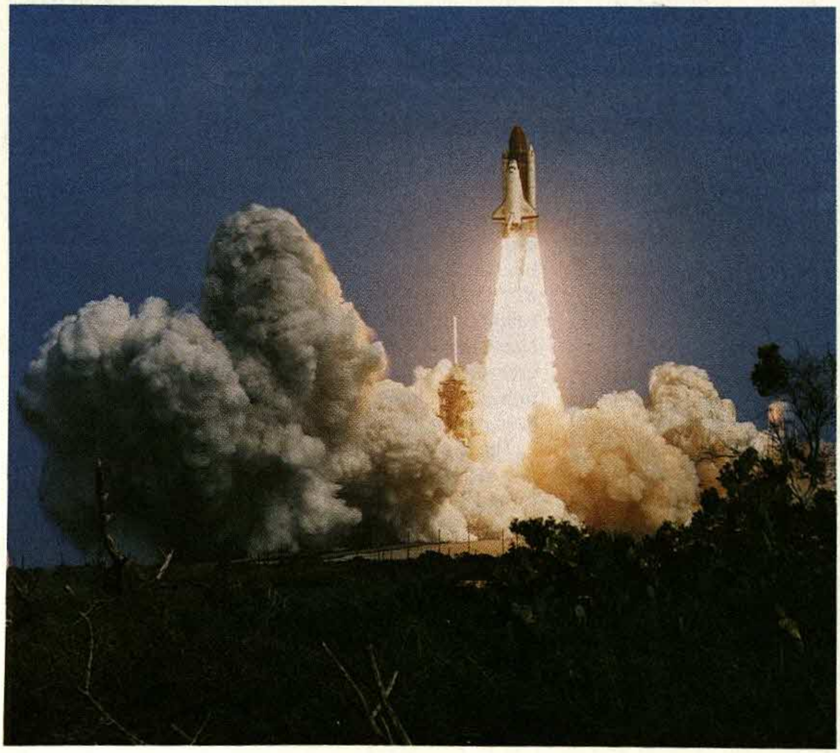
Most national anthems are composed as marches, hymns, and anthems. The most famous anthem composed as a march is the "Marseillaise", written during the French Revolution in 1792. It was sung by a group of republican soldiers as they marched into Paris, and quickly became popular. "La Marseillaise" was adopted as France's national anthem in 1795. It was banned several times before being permanently adopted in 1879.

Among other marches is Singapore's national anthem "Majulah Singapura", composed by Zubir Said. It was first performed in 1958, and adopted as the national song a year later. The opening line, "Let us, the people of Singapore, march forward together", expresses the need for multi-racial unity.

Many national anthems take the form of hymns or sung prayers to God. The United Kingdom's (UK's) "God Save the King" (or "Queen") is the oldest of all such songs. The author and composer are unknown, but the anthem was already well-known in the mid 1700's. It became the official anthem of the UK in 1825. The popular hymn *Nkosi Sikelel' iAfrika* (God Bless Africa) was adopted as one of South Africa's two national anthems in 1994. It was composed by Enoch Sontonga, a South African teacher, in 1897.

For many years, the national anthem of the United States was "My Country, 'tis of Thee" using the same tune as "God Save the King." In 1931 the present anthem, "The Star-Spangled Banner" replaced it. However, this was not a new song. The melody had been written by John Stafford Smith in the late 1700's, and the words by Francis Scott Key in 1814.

Japan was the first of the countries of the Far East to



Atlantis, one of NASA's reusable space shuttles, lifts off from launch pad 39B at the Kennedy Space Center in Florida, U.S.A. The Shuttle makes frequent trips to place satellites into earth orbit and to carry instruments for experiments and research in space.

adopt a national anthem. The Japanese anthem "The Reign of our Emperor" was introduced in 1893. In 1949, the new People's Republic of China adopted its anthem "March on, Brave People of Our Nation". During the 1960's, many newly independent states in Africa commissioned new national anthems.

National anthems have frequently been changed to reflect the changing political situation in a country. At the beginning of the century, for instance, Russia's anthem was "God Save the Tsar". After the Revolution of 1917, the Communist "Internationale" was adopted instead. This was replaced in 1943 by the anthem of the U.S.S.R., "Unbreakable Union of Freeborn Republics". In 1991, the U.S.S.R. broke up into separate republics, and Russia adopted "Patriotic Song" as its anthem.

Some national anthems are songs which praise the beauty and richness of a country. The national anthem of the Philippines begins "Beloved land, pearl of the Orient". The music was written by Julian Felipe to celebrate the nation's declaration of independence in 1898. The words were originally sung in Spanish, but were later translated into Tagalog. Australia's national anthem "Advance, Australia Fair" was written in 1878, but was not officially adopted until 1984.

Several national anthems are *historical,* and commemorate famous people or events from history. Denmark's "King Christian" and Haiti's "La Dessalinienne", for example, remember national heroes of the past.

In recent years, some historical anthems have been written especially to celebrate a nation's struggle for independence from a foreign power. The Indian poet Rabindranath Tagore wrote the words beginning "Thou rulest the minds of all people" in 1912. They soon became associated with the Indian independence movement and were set to music. The anthem was sung at the famous midnight session of the Constituent Assembly on August 14, 1947, when British rule ended in India. It was adopted as the official anthem in 1950.

Other national anthems on a historical theme include the song of Guinea-Bissau. This begins "Sun, sweat, verdure and sea, centuries of hope and pain."

A few national anthems make use of folk music. Most are content to imitate Western musical forms. Among those countries which have based their anthems on ethnic music is Malaysia. The tune of "My Country, My Native Land" is based on a traditional Negara melody which was once the anthem of the state of Perak. The words were written by a government committee and adopted as the national anthem in 1957. Each of the 13 princely states of Malaysia also has its own anthem.

A few nations have anthems with no words at all. Instead, their national anthems take the form of fanfares played on brass instruments. Several Middle Eastern countries, including Kuwait, Bahrain, and the United Arab Emirates, have fanfares as their official music.

Related articles. For the national anthems of many countries, see the *Facts in brief* section of the country article, such as **Italy** (Facts in brief). See also:

God Save the Queen
Marseillaise
Star-Spangled Banner

National debt, sometimes known as public debt, is the amount of money which a government has borrowed to finance its spending. Governments borrow from their own people, from institutions such as banks and insurance companies, and from other countries. Overseas borrowing is usually known as external or foreign debt. Governments can reduce national debt by raising taxes or reducing government spending. In the past, the main reason that governments borrowed money was to pay for the cost of war. Since World War II (1939-1945), however, many countries have built up large amounts of debt for other reasons. Governments have used the money to help pay for economic development and improve social conditions, or because they want to avoid the damage caused to the country by recession. Many governments borrow to pay for subsidies to nationalized industries, which might otherwise collapse. Sometimes governments borrow money to use in protecting the value of their national currency.

Borrowing by governments from within the country is usually less difficult than borrowing from abroad. To raise money within a country, a government may sell *government stock* (long-term interest-bearing bonds) or *national savings certificates. Treasury certificates* or *bills* are issued by the government with a promise to pay back the loan after a short period, of perhaps three months from the date of issue. Specialist financial institutions buy and sell these bills on *money markets.*

Foreign debt is raised when a foreign government or foreign institutions such as banks are prepared to make loans. For many countries this may be the only way they can obtain the money they need to keep their economies expanding. Very poor countries may borrow from abroad to make sure their people are able to eat and be housed. The problem with foreign debt is that it has to be paid back in foreign exchange. This usually means that developing countries have the difficult task of increasing their exports to earn more foreign exchange.

The cost of borrowing money within a country and abroad varies a great deal. Factors such as the international situation, a country's general level of inflation, and the country's ability and past record of repayment on loans all affect the cost of borrowing. Some countries are regarded as a good risk because they usually pay back their loans, or the interest on them, regularly, as arranged when the loan was made. Other countries are regarded as a bad credit risk because they have been slow at paying off their debt. The cause may be political or economic and may be beyond their control. Or it may be that the government is not good at managing its finances and wastes money.

Debt burden. A country's national debt is often referred to as a debt burden. If a country has a strong economy, the debt may provide capital that helps the economy. A weak economy's debt may simply be adding to or postponing the country's problems. A government's borrowing from the people and institutions in its own country is often regarded as being a burden on future generations. It is assumed they will have to pay increased taxes to meet the cost of interest and repayment of the loans. However, if the loan is used to develop new industries or to create more wealth, increased taxation may not be necessary.

Many developing countries forced to borrow abroad through lack of funds at home became heavily indebted during the late 1970's and early 1980's. This was because of a big increase in the price of oil, which many countries had to import. The sharp rise in oil prices led to other large price rises. The result was a period of high inflation. At this time, the governments of many developing countries increased their borrowing to pay for imports and to finance their development programmes. Interest rates rose and the cost of borrowing became very high.

Many countries began to have difficulty in meeting their debt repayments. In August 1982 there was a "debt crisis" caused by the inability of Mexico to meet its repayment obligations. The banks responded to the situation by cutting back on their loans. The banks' decision affected nearly all developing countries by reducing funds available to them.

By 1989, the external debt of the developing countries reached 1,290 billion U.S. dollars. Many countries faced major difficulties over debt repayment. The ability to pay is usually measured by the *debt service ratio.* This is the percentage of export earnings needed to service the debt. The amount of export earnings needed to service developing country debt rose, on average, from 16 per cent in 1981 to a peak of 23 per cent in 1986, before falling to 18 per cent by 1990. Countries in Latin America and Africa were least able to meet their debt obligations with debt ratios of 43 per cent and 27 per cent respectively. The position of many Asian countries improved during the 1980's in line with their faster economic development.

Latin American countries have borrowed more heavily than other regions, and their debts are of the greatest concern. If these countries failed to repay their debt the entire international banking system of the world would be affected.

Some countries have tried to reduce their national debt by limiting their borrowing needs through reducing public investment and spending. Sometimes, this has led to reduced economic growth and a curb on exports. In the early 1990's, the International Monetary Fund advised many countries with large debts about making economic improvements.

Some industrially developed countries built up large public debts in the 1970's, 1980's, and early 1990's. These debts became worrying in the 1990's and the countries—including Australia, Canada, Italy, New Zealand, the United Kingdom, and the United States—sought to reduce their debt burdens.

National gallery is a nationally owned gallery that houses a nation's finest art collections. Some national galleries, such as those of Austria, France, the Netherlands, and Spain, contain many works by national painters. The Picture Gallery in Vienna contains the world's finest collections of paintings by Pieter Bruegel and Albrecht Dürer. The Louvre in Paris contains many masterpieces by Nicolas Poussin, Claude, Jacques Louis David, Eugène Delacroix, and Paul Cézanne. The Louvre also contains many famous Italian works. The Rijksmuseum in Amsterdam contains the world's finest collection of paintings by Franz Hals, Rembrandt, Jakob van Ruisdael, and Jan Vermeer. The Prado in Madrid contains many masterpieces by Diego Velázquez, Bartolomé Murillo, and Francisco Goya.

Italy has no single national gallery. But such galleries as the Uffizi in Florence, the Accademia in Venice, and the Brera in Milan contain many fine paintings, mostly by Italians. The United Kingdom and Germany have separate national institutions for international and national paintings. The Berlin picture gallery has many fine works by early Dutch painters and French painters of the 1700's. The National Gallery in London is noted for its even coverage of international schools throughout the centuries. Most European national galleries were founded between 1780 and 1870.

The National Gallery of Art in Washington, D.C., was founded in 1937. It opened in 1941. It has collections of European and American art from the 1100's to the present.

See also **Museum** (Art museums).

National Geographic Society is the world's largest nonprofit-making scientific and educational organization. It was formed in 1888 in the United States to gather and spread geographic information throughout the world. It has more than 10 million members in approximately 185 countries. The society has sponsored and supported more than 4,000 expeditions and research projects.

The society distributes information through *National Geographic Magazine,* a monthly journal; *National Geographic World,* a magazine for children; *Research and Exploration,* a scholarly research journal; *National Geographic Traveler,* a travel magazine; authoritative books; and an information service for the press, radio, and television. It produces atlases, globes, maps, filmstrips, computer and videodisc programs for schools, and television programmes. The society also sponsors a programme to train geography teachers and promote the teaching of geography to classrooms.

Among the projects the National Geographic Society has helped sponsor are the historic polar expeditions by Richard Byrd and Robert Peary. It helped back the first successful United States expedition to the top of Mount Everest and aided in the discovery of the wreckage of the sunken *Titanic.* It also sponsored excavations in East Africa that uncovered fossils of a primitive human being called *Homo habilis* that lived about 2 million years ago. The society's headquarters are located at Washington, D.C., U.S.A.

National Health Service (NHS) is the United Kingdom's (UK's) healthcare system, which provides state-funded medical services to all residents. Other countries have similar schemes with different names. The services, which include preventive and therapeutic measures and allied community services, are paid for mainly from general taxation. But employed people make an additional contribution through a compulsory health insurance scheme. Doctors, nurses, and other personnel are under contract to the government. The NHS, with its hospitals, health centres, and allied facilities, is publicly owned.

The system of state-run and state-funded health care available to everyone is based on two important ideas. First, illness in the individual is a matter of social concern. For example, a father who is ill cannot work to support his family. Secondly, the government—and through it every individual—accepts responsibility for maintaining a healthy population.

Many people make use of the services of the NHS by consulting a local doctor called a *general practitioner* (GP). General practitioners are funded by the government and can buy support from many NHS agencies in the community, such as nurses, ambulances and day

The UK's National Health Service provides free medical care. Hospital outpatients wait for consultation or treatment.

hospitals, or refer patients to a hospital-based specialist. Every person is entitled to be on a GP's *list* (panel of registered patients). GP's are directly responsible to the secretary of state for health.

Most UK hospitals are run by separate NHS Trusts. Beginning in 1990, the NHS was reorganized within a system of purchaser-provider. This system was intended to be cost-effective, competitive, and more efficient in the delivery of service to patients. Under the purchaser-provider system, the NHS Executive decides overall professional policies, which are put into effect by 14 Regional Health Authorities (RHA's). The RHA's act as purchasers. They identify local needs and negotiate prices for services from the service providers—Community Trusts and Hospital Trusts. Community Trusts provide home care, nursing, physiotherapy, and supervision within the community. They also buy in services such as dental treatment, eye testing, child welfare clinics, family-planning, vaccination, and screening. Hospital Trusts provide services such as surgery and diagnosis.

Fundholder GP's can purchase services directly from the Trusts. In theory, they can purchase services from anywhere in the country. Family Health Service Authorities (FHSA's) monitor and plan local GP services.

Funding is provided by central government and allocated by the Department of Health to the RHA's in England and Wales. The RHA's in turn decide allocations for districts. Separate allocations are made for Scotland and Northern Ireland. All bodies are ultimately accountable to the Department of Health and thereby to Parliament.

Since its foundation in 1948, the NHS has been able to maintain adequate standards of care for relatively modest costs. The UK spends less of its gross national product on health care—and its administration—than other industrial nations. However, costs are rising—with inflation, with the aging of the population, and with increasingly sophisticated technology and treatment.

Dental nurses are among the many public servants who provide important services to New Zealanders. The nurses shown above are being trained to provide dental care for schoolchildren.

The most prevalent system, found in most Western European countries and in some other countries, has compulsory *national health insurance (NHI)* administered by the state to cover the expenses of health care. This may be topped up by contributions to private insurance schemes. New Zealand's system, for example, covers in- and out-patient hospital care in state hospitals, while the government subsidizes direct payments to GP's and for private specialist and hospital treatment.

In Canada's NHI scheme, each province has its own programme, compulsory in some, voluntary in others. Almost all Canadians are covered for major health-care expenses, with additional private insurance for those who want it. The national government shares the cost of NHI with the provinces.

Australia's national health scheme, known as Medicare, was introduced by a Labor government in 1984. Under Medicare, all Australians are covered for the costs of basic health and hospital care. Medicare is financed by a tax levied on all incomes. About 65 private health insurance funds offer insurance for services and items not covered by Medicare. Such services and items include private hospital treatment, dental work, and spectacles. Medibank Private, a government organization, competes with the private health funds by offering insurance coverage for items not covered by Medicare.

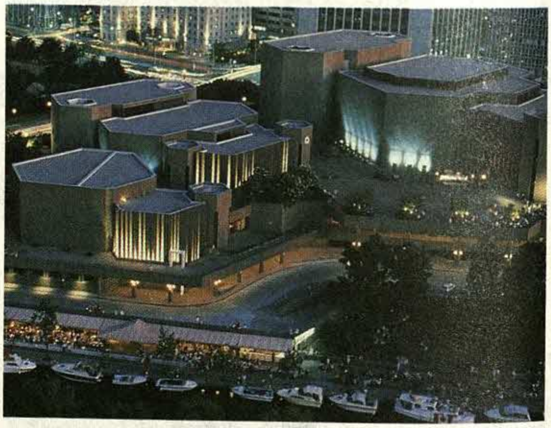
Developing countries have different health-care priorities. Their populations are still at risk from diseases preventable by public health measures—clean water and good sanitation, immunization, adequate nutrition and housing, and antenatal and baby care.

The Constitution of India declares that the state is responsible for health care. Two agencies—the Ministry of Health (MoH) and Family Welfare, and the Directorate-General of Health Services—co-ordinate and direct national health strategies. The rural health division of the MoH reaches into thousands of scattered villages with a corps of primary health-care workers known as village health guides. Rural areas are provided with subcentres, primary health centres and community health centres, equipped with laboratory facilities, X-ray machines, in-patient beds, and medical specialists.

This programme for bringing primary health care to the entire country depends on community involvement, including donations in cash, in kind, and in labour. The Indian MoH allocates extra funds to deprived regions and also supports the training of paramedical staff, especially women.

National heritage refers to all those things that a country considers to be part of its identity and traditional cultural wealth. People feel that they have inherited this wealth from their past. For example, the Eiffel Tower in Paris is part of France's national heritage. It is such a famous structure that people around the world recognize it as a symbol of France.

The national heritage may include a country's tradi-



A long tradition of tartan dress and festive dancing, *above left,* forms part of the national heritage of Scotland. For Canadians, the function and architecture of Ottawa's National Arts Centre, *above,* is held in great esteem. Niagara Falls, *left,* is a natural resource of Canada and the United States. Michelangelo's David, *right,* is part of the rich heritage of Italy.

tions, historic documents, art treasures, historic buildings and monuments, and areas of natural beauty. Many countries set aside areas as national parks to preserve wildlife and the environment (see **National parks**). Museums display works of art and other items of historical importance. Many governments have passed laws to prevent such works from being sold and taken abroad. Funding for the national heritage may come from governments, charities, or voluntary donations.

National income is the total of all income earned in a country during a specific period, usually a year. This figure shows whether an economy is growing or declining. Economists use national income figures to compare the economies of various countries.

Determining national income. Economists calculate national income in either of two ways. One way is based on what individuals and businesses earn. The other is based on the production of goods and services. Each method provides the same national income figure because the amount that people earn equals the value of the goods and services produced.

National income based on earnings includes all the income that is earned in a nation during a certain period. This includes wages and salaries, interest, profits, and rents.

To find national income based on production, economists first determine a nation's *gross national product.* This figure represents the total value of the goods and services produced by a nation during a specific period. Economists find the national income by subtracting *depreciation* and *indirect business taxes* from the gross national product. Depreciation includes the normal decline in the value of buildings and machinery as a result of doing business. Indirect business taxes are paid by buyers of goods and include sales and excise taxes. The difference between gross national product and depreciation is called the *net national product.*

National income may be affected by both *inflation* (rising prices) and *deflation* (falling prices). For example, if the amount people earn increases 10 per cent in one year, the national income figure for that year will rise 10 per cent. But if prices also rise 10 per cent, people will not be able to buy any more goods or services than they did during the year before. Thus, the national income figure is 10 per cent higher because of inflation, not because of economic growth.

In order to compare national income figures for two or more years, economists adjust the national income to allow for inflation or deflation. The adjusted figure is called *real national income.*

Importance of national income. National income figures show the rate at which a nation's economy changes. These figures also show the stability of the economy. The economy may be unstable if national income varies greatly from year to year. National income figures also show how income is distributed in the forms of wages, interest, profits, and rents. For example, wages, salaries, and employee benefits may account for about 75 per cent of the national income. Interest, profits, and rents provide the rest of the national income.

Both government and industry adjust their budgets in terms of the level, distribution, and rate of change in national income. If national income falls, for example, the government might cut taxes, giving people more after-tax income to spend. If people spent this additional income on goods and services produced within the country, business activity would rise. Jobs would be created, and national income would increase.

National income figures include only payments and losses for which records are kept. As a result, these figures do not fully show the level of a nation's well-being. A housewife receives no salary for doing housework, and so her work does not raise the national income. On the other hand, environmental pollution causes great economic loss. But no one knows the total cost of this loss, and so economists cannot subtract it from the national income.

Changes in national income. National income varies, depending on the efforts of workers, the level of employment, and the quality and quantity of *fixed capital.* Fixed capital includes the buildings and machinery used to provide goods and services. Improvements in fixed capital may create more jobs and raise the national income.

See also **Capital; Gross national product; Income; Standard of living.**

National insurance is a state scheme in the United Kingdom (UK) and the Republic of Ireland that provides financial support for any family whose earnings are interrupted through unemployment, sickness, widowhood, or retirement. The money to pay for the benefits comes from regular contributions paid by all wage earners and employers. An agreement between the United Kingdom and the Republic of Ireland provides for the payment of pensions to people of either country who have worked in the other. The national insurance scheme was introduced in 1911.

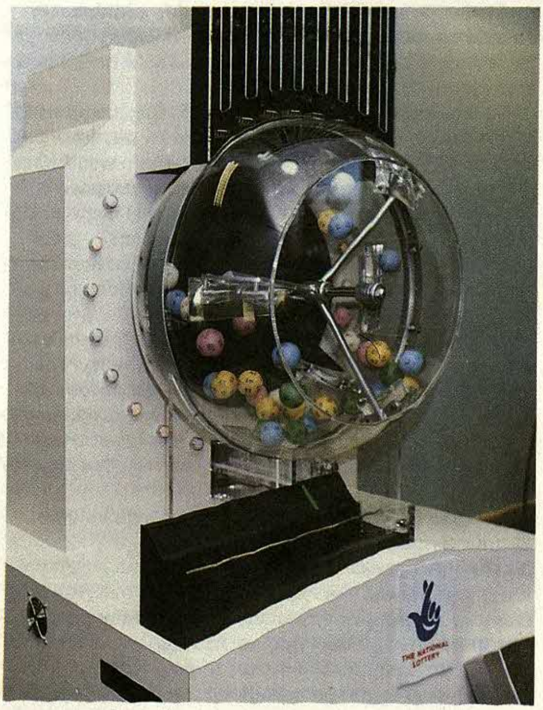
In the United Kingdom, the Department of Social Security runs the scheme. The department controls several hundred local offices. In addition to wage earners, self-employed and non-working people with annual incomes above a specified level also pay contributions. Part of each contribution goes towards an industrial injuries scheme, which helps people who have sustained accidental injuries or have contracted diseases as a result of their work. In addition to contributions, the insurance funds receive payments from the exchequer and income from interest on investments. The funds pay out large sums of money a year to those in the scheme.

People insured under the scheme pay their contributions through a system in which employees have their national insurance contribution removed from their wages by their employers. Self-employed people make direct contributions.

In Northern Ireland, national insurance is run by the Department of Social Services, and the system is similar to that in the rest of the U.K.

In the Republic of Ireland, the Department of Social Welfare administers a national insurance scheme similar to that in the UK. Membership of the scheme is not compulsory for people earning more than a specified sum each year. Female contributors receive a cash grant on marriage. Building workers pay extra contributions against loss of work due to bad weather.

National lottery is a game of chance run by a country's government. People buy numbered tickets, and winning numbers are selected at random at a public drawing. A person who has a ticket with the winning



The draw machine for the UK national lottery ejects numbered balls at random to determine the winning numbers.

numbers wins a cash prize. Sales of tickets raise money for the government. See also **Lottery.**

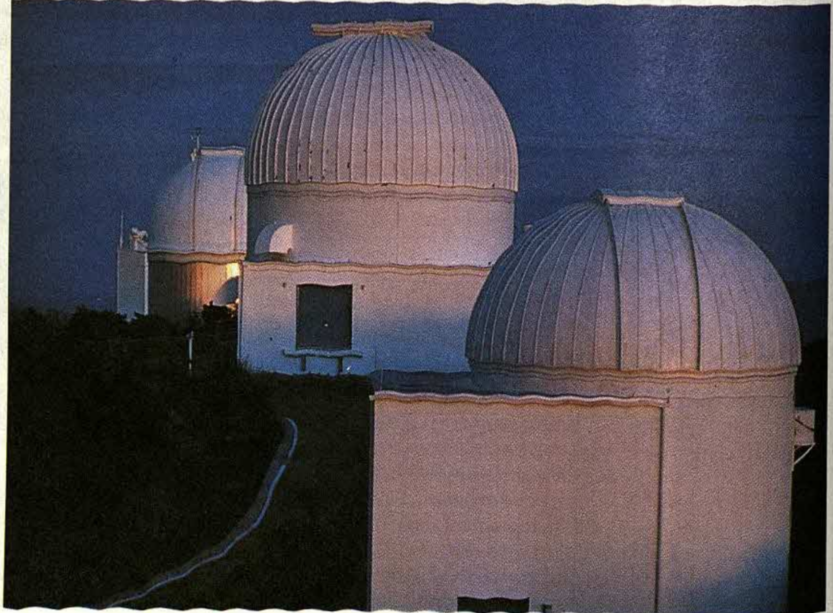
National Optical Astronomy Observatories are a group of three United States research centres for astronomy. They are Kitt Peak National Observatory, Cerro Tololo Inter-American Observatory, and the National Solar Observatory. The National Optical Astronomy Observatories, often called *NOAO,* was established in 1984 to combine the major centres of the United States for *optical astronomy* into a single organization. Optical astronomy involves the use of *optical telescopes,* which capture visible and infrared light to form images of the sun, the planets, and other relatively nearby objects (see **Astronomy** [Observing with telescopes]).

Kitt Peak National Observatory is on Kitt Peak, about 95 kilometres southwest of Tucson, Arizona. The observatory is the U.S. centre for optical astronomy in the Northern Hemisphere. Astronomers at Kitt Peak study stars and planets through 16 optical telescopes, the world's largest single collection. This collection includes the huge Mayall telescope, which contains a mirror 400 centimetres in diameter. Astronomers use the Mayall telescope to study faint galaxies and quasars.

Cerro Tololo Inter-American Observatory is on Cerro Tololo, a mountain about 80 kilometres east of La Serena, Chile. Astronomers at this centre study stars and constellations that are not visible in the Northern Hemisphere. The observatory's 400-centimetre telescope is the largest optical telescope operating south of the equator.

The National Solar Observatory, based in Tucson, conducts studies of the sun. The observatory operates the Vacuum Tower telescope and other telescopes on Sacramento Peak, New Mexico, and the Robert R. McMath solar telescope and another vacuum telescope at Kitt Peak. The McMath telescope is the world's largest solar telescope. It uses a system of three mirrors to produce an image of the sun that is about 80 centimetres in diameter.

NOAO also conducts several specialized programmes in astronomy. One such programme, called the Global Oscillation Network Group (GONG) Project, uses an international network of automated observatories to study small vibrations on the sun's surface. Observations of these vibrations help scientists understand activity inside the sun.



Kitt Peak National Observatory, in Arizona, U.S.A., is host to 300-400 astronomers from around the world each year.

Another NOAO programme, called the Advanced Development Program, is engaged in developing new techniques to make better use of optical instruments on the ground. One such technique, known as *adaptive optics,* electronically reduces distortion caused by the atmosphere in order to produce clearer images of celestial bodies. This programme is also involved in designing a National New Technology Telescope that will use four mirrors. Each mirror will be 792 centimetres in diameter.

NOAO is operated by the Association of Universities for Research in Astronomy (AURA), Incorporated, which consists of 20 U.S. universities. AURA is under contract to the National Science Foundation, an agency of the U.S. government.

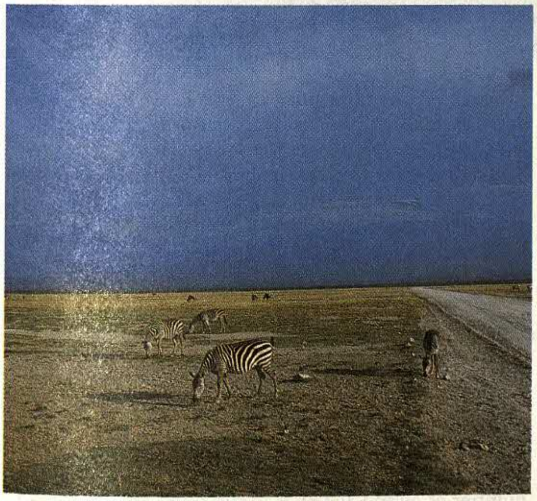
See also **Observatory; Telescope.**

National parks are areas set aside by governments to preserve natural landscapes, wild animals and their habitats, and places of cultural, historic and scientific interest. They provide opportunities for recreation and enjoyment, education, and inspiration for people concerned about nature and conservation. The authorities in charge of the parks try to protect them from interference that would damage or change their character.

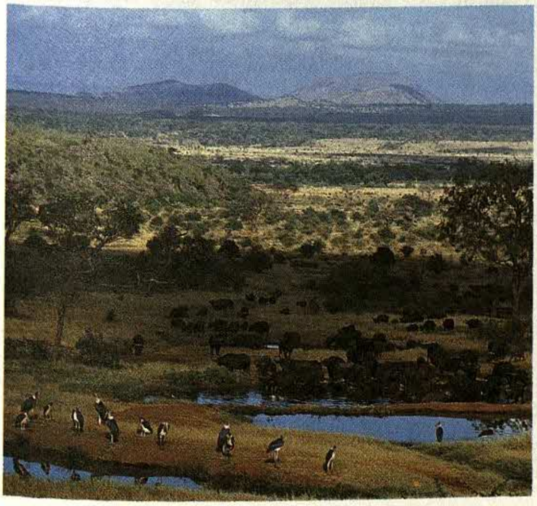
The first country to set up a national park was the United States in 1872. Now more than 100 countries have national parks or similar areas, such as nature reserves, wildlife sanctuaries, state parks, and state and national forests. By the late 1980's, there were more than 3,500 national parks and wildlife reserves around the world. Together they covered about 4,000,000 square kilometres.

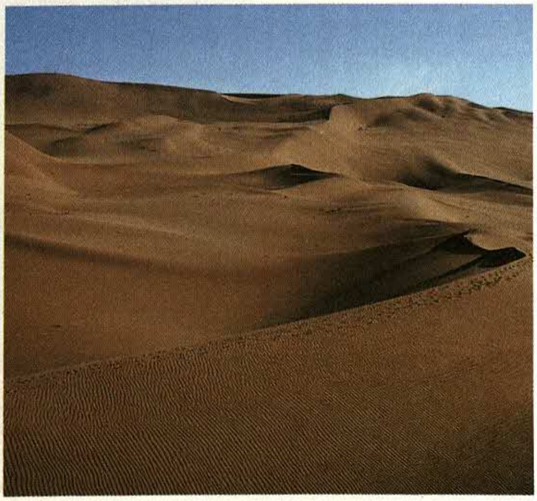
Africa

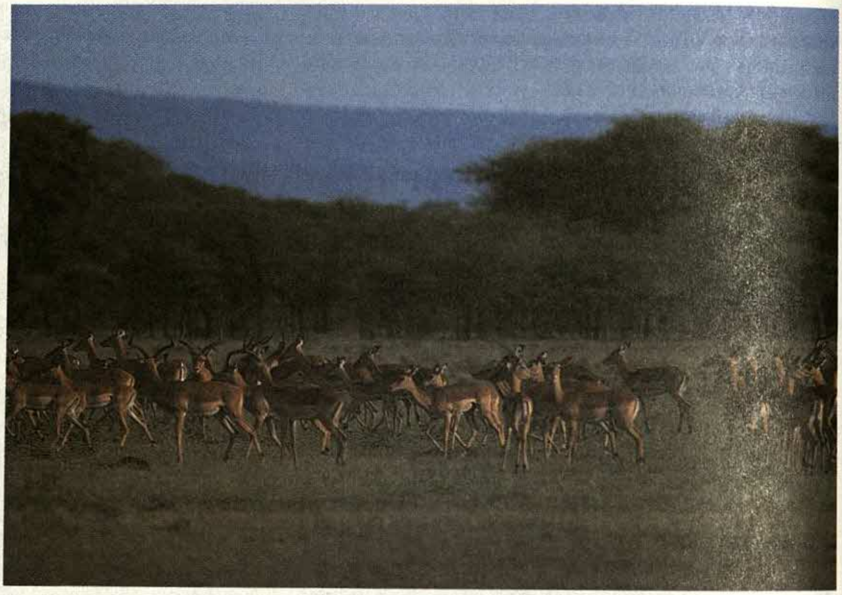
Africa's many national parks and reserves are especially well known for their abundant wildlife, which is now a major tourist attraction. The best known parks are in open savanna regions, where visitors can observe animals with ease. The parks in the forest zones are less accessible and the wildlife is more difficult to see.



Africa's many famous national parks include Amboseli National Park, Kenya, *above left,* Kruger National Park, South Africa, *above right,* Tsavo National Park, Kenya, *below left,* and Namib-Naukluft National Park, Namibia, *below right.*







A herd of impala roams across the Serengeti National Park, an area of open savanna in Tanzania where many wild animals may be seen during their annual migration.

Several countries in eastern and southern Africa now have flourishing tourist industries based mainly on their national parks. This is especially true in Kenya and Tanzania in East Africa. Kenya's national parks cover more than 34,000 square kilometres. They range from the vast Tsavo National Park, which, with an area of nearly 21,000 square kilometres, is one of the world's largest, and the small Nairobi National Park, which covers only 115 square kilometres. The Nairobi Park is especially popular, because it lies only 8 kilometres from the centre of the capital city of Nairobi. Tsavo National Park contains such animals as buffaloes, cheetahs, elephants, hippopotamuses, leopards, lions, rhinoceroses, and zebras. Tanzania contains the Serengeti National Park, famed for its animal migrations at the start of the dry season; Kilimanjaro National Park, which contains Africa's highest peak; and Lake Manyara National Park, which has huge herds of buffaloes.

South Africa's most popular park is the Kruger National Park, established as a game reserve in 1898. It contains buffaloes, elephants, leopards, lions, and more than 400 species of birds, including endangered species such as pink-backed pelican and Pel's fishing owl.

Southern Africa also has the spectacular Victoria Falls National Park and the nearby Hwange National Park in Zimbabwe; the Etosha Pan National Park, a swampy area in northern Namibia, which is one of the world's richest wildlife areas; and the Kafue National Park in Zambia.

In Central Africa, Zaire has several parks. One of the most accessible is the Virunga National Park, which contains active volcanoes and habitats ranging from wooded savanna to icy mountain peaks. It is also famous for its mountain gorillas. The Waza National Park in Cameroon has a rich and varied animal life, with a large number of giraffe, which is increasing with the spread of acacia woodland. There are also elephant, aardvark,

Richtersveld National Park is situated in the west of Northern Cape Province, South Africa, bordering with Namibia.

Indian one-horned rhinoceroses are a protected species that live in the Kaziranga National Park in Assam, in northeastern India.

lion, and waterbuck. Birds that can be found there include ostrich, ground hornbill, white-faced tree duck, and standard-winged night jar.

West Africa has fewer national parks than eastern and southern Africa. The region's best known parks include the "W" National Park which occupies an area of mountain and savanna country in Benin, Burkina Faso, and Niger; and Komoé National Park in Ivory Coast.

In North Africa, the Toubkal National Park is situated toward the western end of the High Atlas mountains. The park covers the mountain range Jbel Toubkal, which is more than 4,000 metres high. The animals there include Barbary ape, Cuvier's gazelle, porcupine, and hyena. Birds in the park include bald ibis, bearded vulture, and black-winged kite.

Asia

Much of southern and southeastern Asia is densely populated. This has led to a sharp decline in animal habitats and populations. Many governments, aware of the threat to the flora and fauna, have set up parks and reserves to protect rare species. For example, the Chinese have established the Hsifan Reserve to protect the giant panda.

Another rare animal, the Indian tiger, is now protected in several reserves, including India's first national park, the Corbett National Park in the foothills of the Himalaya, near Delhi. The Gir Lion National Park, in Gujarat state, is the last natural habitat for the rare Asiatic lion. The Kaziranga National Park in Assam protects the one-horned rhinoceros, and the Keibul Lanjoo National Park in Manipur contains the world's rarest deer, the Sanghai or Manipur brow-antlered deer. Some people consider that the best place to observe India's rich and varied wildlife is the Kanha National Park in central India.

Southeast Asia's parks include the Angkor National Park, Cambodia, which contains impressive Khmer ruins surrounded by rainforest. The Kinabalu National Park, in Sabah, Malaysia, has more than 800 species of orchids and more than 500 kinds of birds. Thailand's Khao Yai

Asahi Mountain, a volcano in Hokkaido, Japan, is one of the attractions of Taisetsuzan National Park.

Visitors to Taman Negara National Park, on peninsular Malaysia, can walk through the rainforest and see its rich wildlife.

National Park is also renowned for its birdlife, together with some large caves and a wide variety of animals. Volcanoes form the centrepieces in the Mayon Volcano and the Mount Apo national parks in the Philippines, while the Bataan National Park on Manila Bay was set up to commemorate the battles fought there during World War II (1939-1945).

Australia and New Zealand

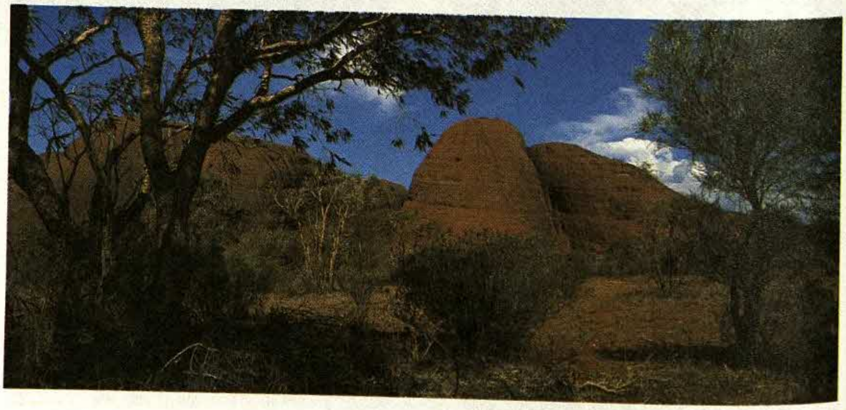
Australia and New Zealand both contain large regions that are loosely called *wilderness areas.* Examples include much of the Cape York Peninsula; southwestern Tasmania; the rugged areas of the Kimberleys in Western Australia; and the heavily forested southwestern highlands of the South Island of New Zealand. Many of these areas have been designated national parks, and some zones in these parks are set aside as wilderness areas, which gives them a more strongly protected status. For example, such areas as the Jajungal Wilderness Area in Kosciusko National Park, New South Wales, cannot be exploited by mining or timber companies, and roads and buildings cannot be constructed there.

Australia's parks include the Royal National Park in New South Wales. The park covers rugged coastal land, heath-covered sandstone hills rich in wild flowers, and wet gorges swathed in rainforest. It was set up in 1879 and is the world's second oldest after Yellowstone in the United States. The Kosciusko National Park, also in New South Wales, covers about 6,640 square kilometres and is one of the few habitats of the rare mountain pigmy possum. The Northern Territory contains the Kadadu National Park on the edge of Arnhem Land, which is rich in Aboriginal rock art, grasslands and wetlands, and Uluru National Park, which contains Ayers Rock.

Queensland has more than 300 national parks, ranging from areas of desert to well-watered regions with freshwater lakes, sandstone gorges, and waterfalls.

Victoria has 31 national parks. The largest is Grampians National Park which has nearly a third of Victoria's native plants and a rich wildlife, including echidna, platypus, feathertail gliders, and the tuan, a carnivorous marsupial.

New Zealand's national park system dates back to the foundation of its first park in 1898. The parks provide important wildlife sanctuaries. Many of them are areas of wilderness without buildings or roads. One of the best known is the Fiordland National Park in the southwestern part of South Island. It covers about 12,000 square kilometres of magnificent glaciated scenery and contains unusual birds, such as kiwis, keas, wekas, and takahe. New Zealand's other parks are Urewera, Tongariro, and Egmont in the North Island, and Abel Tasman, Nelson Lakes, Arthur's Pass, Mount Aspiring, and Mount Cook in the South Island. Mount Cook National Park includes New Zealand's highest peak, the snow-capped Mount Cook, and many other high peaks.



The Olgas are gigantic, dome-shaped rocks 30 kilometres west of Ayers Rock. Both rock outcrops are part of the Uluru National Park in the Northern Territory of Australia.

Rolling hills covered in heather are typical of the landscape of Dartmoor, in Devon, southwest England.

Europe

The first national parks in Europe were set up in Sweden in 1909. They include the Abisko and Sarek national parks in Swedish Lapland. Another pioneering country was Italy, whose oldest park, the Gran Paradiso (1922), contains majestic Alpine scenery, the habitat of the chamois and ibex.

Some eastern European countries also led the way with conservation policies. Today, eastern Europe has numerous parks, including the High Tatra National Park in the Czech Republic, home of bears, wild cats, lynxes, marmots, otters, and wolves, and Bialowieski National Park in Poland, which is a breeding ground for the European bison.

In Russia, hunting in the tundra and taiga, together with economic development that took place before 1991, when Russia was part of the Soviet Union, have taken a tremendous toll of wildlife. As a result large areas in both the European and Asian parts of the country are nature reserves, saving many species from near extinction.

Europe is a small continent and much of its original vegetation, especially in temperate areas, has been removed. As a result, many of the continent's national parks contain landscapes modified by human activity, together with working farmers. The setting up of national parks in such areas is intended to protect traditional forms of land use, and to preserve wildlife and areas of scenic beauty.

The national parks in England and Wales are maintained by the government, but they are not public property, and visitors may not trespass on private land within the boundaries. The 10 national parks, all designated in the 1950's, are the Peak District, the Lake District, Snowdonia, Dartmoor, the southern Dyfed coast, the North York Moors, the Yorkshire Dales, Exmoor, Northumberland, and the Brecon Beacons. Together, they cover 13,600 square kilometres, or 9 per cent of England and Wales. All the parks are supervised by the Countryside Commission (England and Wales).

Scotland has no national parks, but there are three regional parks and 40 "national scenic areas," which together form 13 per cent of the country. Some kinds of development in these areas are subject to consultation with the Countryside Commission for Scotland.

Northern Ireland has the Ulster Countryside Committee and the Nature Reserves Committee to advise on areas of outstanding natural beauty, which numbered nine in the 1990's, covering 2,820 square kilometres. The national parks in the Republic of Ireland are administered by the National Parks Office. The largest Irish park is the Bourn-Vincent National Park in Killarney, County Kerry.

The Alps are the largest mountain system in Europe. Switzerland has set aside an area close to its borders with Italy and Austria as a national park.

The Grand Canyon is 1.6 kilometres deep. Its spectacular scenery and colourful rock walls are protected as a National Park in Arizona, U.S.A.

North America

The world's first national park, Yellowstone National Park, was set up by the United States government in 1872. Today, the United States has 49 national parks which cover an area of about 193,440 square kilometres, or about 2 per cent of the country's total area.

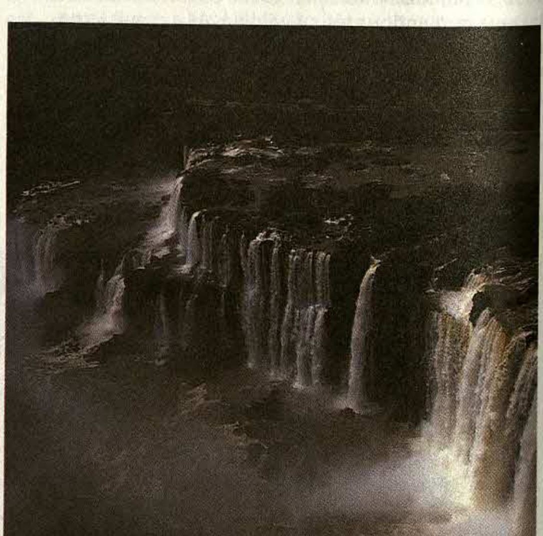
The national parks of the United States are famous for their spectacular scenery. Yellowstone is known for its hot springs and geysers, thundering waterfalls, sparkling lakes, and a variety of wildlife, including bears, deer, elk, and moose. In Carlsbad Caverns National Park, New Mexico, stalactites and stalagmites adorn great underground chambers, while other delicate limestone formations resemble Oriental temples, strange beasts, and upside-down forests of icicles (see **Stalactite; Stalagmite**). The Olympic National Park, in Washington state, contains rainforests almost as thick as tropical jungles, overlooked by rugged peaks flanked by huge glaciers. Grand Canyon National Park, Arizona, is one of the natural wonders of the world. The canyon descends to 1.6 kilometres deep, with walls of black, brown, lavender, and red rocks. The Petrified Forest National Park, also in Arizona, contains rainbow-coloured logs and tree trunks that are millions of years old, and have turned into stone.

Canada also has an extensive national parks system, with 31 national parks, covering about 136,500 square kilometres, and about 700 historic parks and sites. The Wood Buffalo National Park is the largest park, with an area of 44,800 square kilometres. This park, on the border between Alberta and Northwest Territories contains North America's largest herd of American buffaloes, or bison.

Mexico's national parks include the Ixtacihuatl-Popocatépetl National Park, which contains the twin, snow-capped volcanoes near Mexico City. The Pico de Orizaba National Park has some beautiful scenery, including Mexico's highest peak Orizaba (Citlaltépetl), which rises 5,611 metres above sea level.

Central America's parks include the Tikal National Park in Guatemala, which contains ancient Mayan ruins. The varied wildlife includes typical rainforest animals such as howler monkey, spider monkey, anteaters, sloths, ocelot, jaguar, and tapir. Birds include the endangered ocellated turkey. There is also a great variety of amphibians and reptiles. A Central American park of special interest to botanists, because it contains a great variety of plant zones, is the mountainous Altos de Campana National Park in Panama.

The Virgin Islands National Park, which is maintained by the U.S. National Parks Service, is probably the best known park in the Caribbean. It covers two-thirds of the small island of St. John and includes lush rainforest and an underwater snorkelling trail through colourful coral reefs.



The Iguaçu Falls form the border between Argentina and Brazil. The three-kilometre-wide falls can be seen in the Iguaçu National Park, which is managed by both countries.

South America

Large areas of South America are thinly populated. But, increasingly, natural habitats are being destroyed as new regions are opened up to human settlement and economic development. This is particularly true in the Amazon rainforests. However, Brazil has a growing number of national parks, including the Amazonia National Park, a region of tropical rainforest which borders the Tapajós River. Brazil's best known park is probably the Iguaçu National Park which extends into Argentina and includes the impressive Iguaçu Falls.

Argentina was a pioneer in conservation measures in South America. Its parks contain some wonderful mountain scenery. For example, Los Glaciares National Park, which lies on the border with Chile in the southwest, contains beautiful mountains that are reflected in huge lakes that fill glaciated valleys.

Other major parks in South America include the Canaima National Park in Venezuela, which contains Angel Falls, the world's highest waterfall; the Kaieteur National Park in Guyana, site of the huge Kaieteur Falls, one of the world's most impressive waterfalls; part of the Galapagos Islands, which belong to Ecuador; and Peru's highest peak, Huascarán.

The future of national parks

The national parks movement has achieved many successes. Many people now realize that the natural world is under threat, largely as a consequence of the rapid increase in world population, which has led to widespread destruction of wildlife habitats and to pollution. An increasing number of city dwellers also want to enjoy the natural world, and the motorcar has enabled them to leave the cities easily and enjoy the countryside.

The national parks have benefited greatly from this revival of interest in nature. But the very popularity of many parks has begun to threaten the habitats of the animal populations. For example, the Great Smoky Mountains National Park in North Carolina and Tennessee in the United States received 15,000 visits in 1934, but 45 years later the number had increased to 8.3 million. The popularity of many parks has led the authorities to restrict visitors to certain areas and preserve most of the park for the wildlife.

Some national parks are managed more strictly than others. For example, in some developing countries, the cost of managing large national parks is high and the park authorities have great difficulty in controlling poachers. Some poachers simply want food for their families, but others systematically slaughter such animals as elephants for their tusks. Sometimes, however, the populations of some animals in protected areas explodes and the habitat is threatened with destruction by overgrazing. The solution to this problem is *culling,* the selected killing of animals.

Attitudes toward parks also differ. Some people regard the recreational and educational role of parks as paramount. Others want them to be as undisturbed as possible.

Some ecologists have suggested that the creation of national parks, while preserving natural habitats and wildlife, can cause problems for local people. Small tribal groups may be evicted, and denied rights in the areas they consider to be their homelands. People evicted from the parks may suffer poverty and even death when they are forced to move. The effective management of national parks requires the cooperation of local people who live in or near the designated areas. Their conservation must also be part of the overall management strategy.

Related articles in ***World Book*** include:

Conservation
World Heritage list
Wildlife conservation

National Party is the political party that governed South Africa from 1948 to 1994.

The National Party (NP) was founded in 1914 by General J. B. M. Hertzog. It aimed to protect the interests of white Afrikaners against black Africans and British influence. Under the NP, the policy of *apartheid* (ethnic segregation) was reinforced by laws that classified and restricted people according to colour. The NP took South Africa out of the Commonwealth of Nations, making it a republic in 1961.

In 1994 President F. W. de Klerk of the NP led South Africa to its first truly democratic elections, in which the African National Congress was victorious.

National Radio Astronomy Observatory (NRAO) is an organization that operates radio telescopes in the United States (U.S.A.) at Socorro, New Mexico; Kitt Peak, Arizona; and Green Bank, West Virginia. Scientists from the U.S.A. and other countries use these telescopes. The NRAO is financed by the U.S. National Science Foundation.

The NRAO operates the world's most powerful radio telescope, the Very Large Array Telescope, near Socorro. This instrument consists of 27 large, dish-shaped metal mirrors called *reflectors* that collect radio signals from space. Each reflector measures 25 metres in diameter. The reflectors operate as a single instrument. Another NRAO instrument, the Very Long Baseline Array Telescope, began operation in 1993. It consists of 10 reflectors at sites across United States territory, from Hawaii to the Virgin Islands. These reflectors are controlled from Socorro by telecommunications signals sent by a computer, and act as a single telescope.

The NRAO telescope at Kitt Peak has a 12-metre reflector designed to collect radio signals of extremely short wavelengths. At Green Bank, the NRAO operates a 43-metre diameter radio telescope. In addition, the Green Bank Telescope, with a 100-metre reflector, is under construction. It is due for completion by 1996.

The NRAO was founded in 1956 by the National Science Foundation. Associated Universities, Inc., an association of nine U.S. universities, operates it.

See also **Radio telescope.**

National trusts are organizations set up to protect and preserve buildings, landscapes, monuments, and articles which are considered to have special artistic, scientific, or historical value. These organizations are independent, and follow the pattern of the first national trust in the United Kingdom (UK).

The National Trust for Places of Historic Interest or Natural Beauty is an independent charity in the UK. It owns or protects more than 220,000 hectares of land and nearly 350 country houses and gardens in England, Wales, and Northern Ireland. It is the largest landowner in the UK. Many of its properties are open to the public.

The National Trust is not part of any government department. It is run by a council elected by various public bodies and its own members. It has about two million members. Its chief sources of income are legacies, endowments, and members' subscriptions. The trust is not funded directly by the government, but is allowed certain tax benefits.

The National Trust is one of the oldest conservation bodies in the world. It was founded in 1895 by Octavia Hill, Sir Robert Hunter, and Canon H. D. Rawnsley. In 1907, an Act of Parliament empowered the trust to declare its properties *inalienable.* This means that they can never be sold or mortgaged.

The National Trust for Scotland was founded in 1931. It is also an independent body which owns or protects about 40,000 hectares of land, and about 100 major properties in Scotland. These include Falkland Palace in Fife Region; the pass of Glencoe in Highland Region; the St. Kilda Islands in the Western Isles; and Fair Isle in the Shetland Islands.

Several other countries have organizations which are similar to the United Kingdom's National Trust. In the United States, the National Trust for Historic Preservation and the National Register of Historic Places owns and protects scores of important sites. Among these are Custer Battlefield in Montana; the Lincoln Memorial in Washington, D.C.; and Walden Pond in Massachusetts. It was set up in 1949.

Ireland's national trust, called *An Taisce* (The Treasure), was set up in 1948. It administers land and properties for conservation, leisure, and scientific purposes. Its sites include part of the Burren, a nature reserve in County Clare; Athlumney Mill in County Meath; and Garry Lough Mill in County Wexford.

Each state in Australia has its own national trust. The trusts have no powers, but their recommendations are forwarded to the government departments concerned with conservation, planning, and the environment. New South Wales has the oldest trust, founded in 1945. It owns 27 properties, among them Old Government House in Parramatta and the Norman Lindsay Gallery in the Blue Mountains.

New trusts have recently been established in Asia and the Far East. The Heritage of Malaysia Trust is an independent body founded in 1984. Its properties include Rajah Abdullah's Warehouse in Kelang and the National Art Gallery in Kuala Lumpur. There are also national trusts in the Bahamas, Barbados, Bermuda, Canada, Fiji, New Zealand, and Zimbabwe.

In many other countries, the conservation of historic sites and properties is organized largely by government organizations. Examples are the Agency for Cultural Affairs in Japan and the National Archives of India.

National Woman's Christian Temperance Union. See Woman's Christian Temperance Union.

Nationalism is a people's sense of belonging together as a nation. It includes such feelings as loyalty to the nation, and pride in its culture or history. In politics, it is represented by the belief that government should be based upon a group of people called a nation. Nationalists generally believe that each group calling itself a nation should have its own state or country. Nationalist political parties generally assert their nation's right to independence—the "right of self-determination".

Since the late 1700's, nationalism has become an important force in international relations. Nationalistic feelings, particularly the desire of each country to govern itself, have helped change the map of Europe several times since the 1800's. Since the late 1940's, nationalism has also transformed Africa and Asia.

Nationalism is widespread today, but it once did not even exist. People have not always had a sense of nationhood. Early people felt they belonged to cities or tribes. During the Middle Ages, people were loyal to a number of different groups and rulers. For example, a French citizen might have owed loyalty to the duke of Burgundy, the king of France, the Holy Roman emperor, and to the pope.

The rise of nationalism occurred along with the development of a political unit called the *nation-state.* A *nation* is a group of people who share a common culture, history, or language and have a feeling of national unity. A *state* is an area of land whose people have an independent government. A nation-state exists if a nation and a state have the same boundaries.

Nation-states began to develop during the late Middle Ages. Travel and communication improved at that time. As a result, people became increasingly aware of the part of their country that lay outside their own community. Loyalty to local and religious leaders began to weaken, and allegiance to kings grew stronger. By the 1700's, England, France, Spain, and several other countries had become nation-states.

Other peoples developed a sense of nationhood by the early 1800's. But most had not become nation-states. Many people believed that a national group had the right to form its own state. This belief, known as the *doctrine of national self-determination,* caused many nationalistic revolutions in Europe. For example, Greece won independence from Turkey in 1829, and Belgium became independent of the Netherlands in 1830.

Different forms of nationalism later developed in various parts of the world. In the United States, for example, the spirit of nationalism expressed itself in rapid westward expansion during the 1800's. Many Americans became convinced that their nation had a *manifest destiny*—that is, a clear mission to take over all North America.

In western Europe, new feelings of nationalism united the Italians and then the Germans, both of whom were still divided into many states. Each of these peoples combined to form one country out of the states. The unification of Italy was completed in 1870, and Germany became a nation-state in 1871.

In eastern Europe, on the other hand, national groups sought to create smaller states out of the huge Austro-Hungarian, Ottoman, and Russian empires. These demands for national self-determination helped cause World War I (1914-1918) and broke up the empires after the war (see **World War I** [The rise of nationalism]).

During the 1930's, two dictators—Adolf Hitler of Germany and Benito Mussolini of Italy—used nationalism in demanding extreme loyalty from their people. They promoted *integral nationalism,* the belief that a certain nationality was superior to all others. This idea also placed strict limits on who could claim that nationality. In support of integral nationalism, the Nazis killed millions of Jews and other people whom they considered inferior human beings. Germany and Italy also set out to conquer the world. Their actions helped bring about World War II (1939-1945).

After World War II, nationalism led many African and Asian colonies to demand self-government. India and Pakistan won independence from the United Kingdom in 1947. The next year, a nationalistic movement called *Zionism* caused the formation of Israel (see **Zionism**).

By the 1970's, more than 80 other nations had become newly independent. Many of them lacked the long history of shared experiences that had produced nationalism in Europe. But their leaders encouraged nationalism to help develop national unity.

In the late 1980's, nationalism began to grow in many of the Communist countries of Eastern Europe. For example, East Germany started becoming more democratic and nationalism for a united Germany became part of government policy. East Germany and West Germany were reunited in 1990. In other parts of Eastern Europe, nationalism led to the breakup of three states, Czechoslovakia, the Soviet Union, and Yugoslavia. The Soviet Union broke up in 1991 into 15 republics, the largest of which was Russia.

Effects of nationalism can be both good and bad. Nationalism gives people a sense of belonging and pride, and a willingness to make sacrifices for their country. They also take a greater interest in their nation's achievements in such fields as literature and music.

But nationalism also produces rivalry and tension between nations. Desires for national glory and military conquest may lead to war. Extreme nationalism may result in racial hatred and in persecution of minorities.

See also **Fascism; Nation; Patriotism;** and the articles on countries mentioned in this article.

Nationalist China. See **Taiwan.**

Nationality, in law, is a person's status as a member of a certain country. Usually, a person's citizenship is the same as his or her nationality. But the terms do not mean exactly the same thing. For example, before the Philippine Islands became independent, their people were nationals of the United States. They owed allegiance to the United States, but were not citizens of the United States.

Nationality is acquired at birth according to either of two principles. The first is the *jus sanguinis,* or *right of blood,* which gives to a child the nationality of one of the parents, usually the father. The second, called *jus soli,* or *right of the place of one's birth,* makes a person a national of the country in which he or she is born. Most countries use both principles. Every country has the right to determine who its nationals shall be.

In the Commonwealth of Nations, the difference between nationality and citizenship was once important. The Commonwealth is an association of mainly independent countries formerly under British rule. All people living in the Commonwealth were considered to be both British subjects and citizens of their own countries. Today, however, citizens of Commonwealth nations are not considered British subjects. A British subject also may be a citizen of a Commonwealth nation if the subject meets that nation's citizenship requirements.

Nationality groups. Nationality also refers to the fact that many people continue the habits, the customs, and even the language of their native land when they go to live elsewhere. In large cities throughout the Western world, for example, there are China towns and Polish sectors. Some of these people were born outside the country. But in some cases, every member of the group was born in the adopted country.

See also **Citizenship.**

Nationalization is the control and ownership of an industry on a national scale by the government of a country. Industries most commonly nationalized include airlines, electric and gas utilities, mines, postal services, railways, and telephone companies.

In some countries, nationalization plays a vital role in a set of economic, political, and social beliefs called *socialism.* These countries nationalize certain industries to provide better products or services for their citizens. Socialists say that nationalization ensures democratic con-

Nationalist leader Vladimir Zhirinovsky, an opposition politician in Russia, visited Montenegro in 1994. He went in support of Montenegrin nationalists.

trol of these industries. In the past, France and the United Kingdom nationalized many industries for these purposes. But in recent years, political changes have resulted in the sale of many of the British and French industries to private investors. The selling of nationalized industries to private investors is called *privatization.*

Other countries, especially some underdeveloped nations, have nationalized certain industries to remove them from foreign ownership. In the 1960's and 1970's, for example, some countries in the Middle East and elsewhere began to take over oil companies that had been owned chiefly by Americans or Europeans. These countries gained higher profits for themselves by removing the oil industry from foreign ownership and control.

Forms of nationalization. There are several forms of nationalization, based on how the nationalized industry is managed. In the most common form, a *public corporation* is set up as an independent body by law. The government appoints a board of directors that manages the industry. In another form of nationalization, a government department has control of the industry. Such action gives the government close control and management of the industry. In a third form, the government buys part of the stock in an ordinary corporation, and private investors own the rest.

Advantages and disadvantages. Nationalized industries have some advantages over private industries. A nationalized industry can provide vital products or services to the public that would not be profitable for private industry to provide. The government can encourage a nationalized industry to invest and expand during an economic *recession* (slowdown). Nationalized industries can also develop weak parts of the economy and they help to hold down prices during periods of inflation.

Supporters of nationalization say that—in certain industries—a nationalized corporation can provide a more efficient service than private industries. Such industries include electric and gas utilities and telephone companies. Supporters also say that government is too weak unless it has some control over vital industries.

Nationalization has some disadvantages. Many nationalized industries do not make a profit. As a result, the government uses money from taxes to *subsidize* (help pay for) them. Critics of nationalization charge that a lack of competition causes nationalized industries to become inefficient. They say government subsidies keep unprofitable industries alive even though the industries are no longer useful. Opponents also fear that too much power is concentrated in a government if it controls vital industries.

See also **Socialism; United Kingdom** (Government ownership; Social welfare).

Native American. See **Indian, American.**

Native bear. See **Koala.**

Native cat. See **Marsupial cat.**

Nativism. See **Latin-American literature** (Romanticism).

Nativity. See **Jesus Christ** (Nativity); **Christmas.**

NATO. See **North Atlantic Treaty Organization.**

Natterjack. See **Toad.**

Natural bridge is a bridge built by nature. Some natural bridges have taken thousands of years to form. A natural bridge is often the result of water working its way slowly through loose soft rock. If there is a harder layer of rock on top of the soft rock, the harder rock will stay firm and form a bridge. Natural bridges often take the shape of an arch.

Natural childbirth. See **Childbirth.**

Natural gas. See **Gas** (fuel) and **Natural gas liquids.**

Natural gas liquids are certain chemical compounds that can be obtained in liquid form from natural gas. These compounds rank among the world's most valuable energy resources. Natural gas liquids, also called *NGL,* are widely used as fuel, and in manufacturing petrochemicals and other products.

The chief NGL compounds, in order of increasing molecular weight, are ethane, propane, butane, pentane, hexane, and heptane. Chemical manufacturers use ethane in making *ethylene,* an important petrochemical. Butane and propane, and mixtures of the two, are classified as *LPG* (liquefied petroleum gas). LPG is used chiefly as a heating fuel in industry and homes. LPG is also used as a fuel for cars in many countries.

Natural gas liquids are carried in a specially built ship, compressed in large tanks.

Natural gas liquids are classified as *light hydrocarbons.* Hydrocarbons, which occur in natural gas and petroleum, are a group of compounds that contain only the elements hydrogen and carbon. All hydrocarbons become liquid under certain combinations of temperature and pressure, depending on their molecular weight. Light hydrocarbons liquefy at lower temperatures and higher pressures than do heavy hydrocarbons.

There are two main methods of producing NGL, *condensation* and *absorption.* In condensation, natural gas is chilled until it becomes a liquid from which the NGL are extracted. In absorption, processors mix gas with an oil that absorbs light hydrocarbons. NGL are then distilled from the oil. Natural gas processing plants produce most NGL.

See also **Butane and propane; Ethane; Gas** (fuel).

Natural history. See **Nature study.**

Natural History Museum. See **London.**

Natural number. See **Number theory.**

Natural resources are those products and features of the earth that permit it to support life and satisfy people's needs. Land and water are natural resources. So are biological resources on the land and in the water, such as flowers, trees, birds, wild animals, and fish. Mineral resources include oil, coal, metals, stone, and sand. Other natural resources are air, sunshine, and climate. Natural resources are used to make (1) food; (2) fuel; and (3) raw materials for the production of finished goods.

This article discusses natural resources in general.

Uses and importance. Biological resources are the most important natural resources. All the food we eat comes from plants or animals. Since early days, people have used wood from trees for fuel and shelter. Biological resources, in turn, are dependent on other natural resources. Most plants and animals could not live without air, sunshine, soil, and water.

Mineral resources are less important than biological resources in supporting life, but they are extremely important to modern living. Mineral fuels—including coal, oil, and natural gas—provide heat, light, and power. Minerals serve as raw materials for finished goods, such as cars, plastic mouldings, and refrigerators.

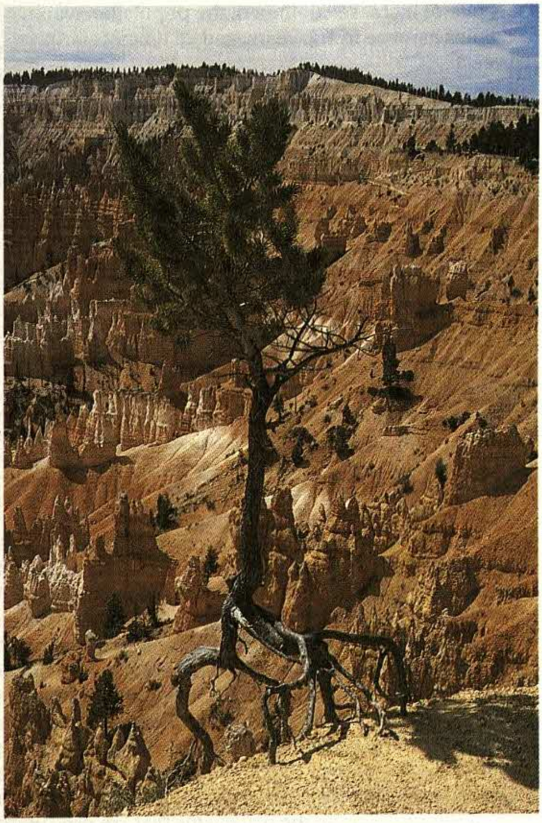
The wealth of a nation depends to an important degree on its natural resources. Most wealthy, or *developed,* countries—including Canada, Australia, and the United States—are rich in natural resources. But some well-to-do nations, such as Denmark and Japan, have few resources. *Developing* countries generally have fewer resources, though some—like China, Indonesia, and Zaire—have many natural resources.

Conservation and development. Since modern civilization—even life itself—depends on natural resources, many people have been concerned about whether there will always be enough. They have asked, for example, what will happen if all the world's petroleum, iron, or coal gets used up.

Scientists and economists believe that people can never use up all the mineral raw materials like iron, aluminium, sand, and fertilizer. There are sufficient quantities in the earth and the sea, and most of the materials can be reused. For example, scrap iron can be melted down and used again in steelmaking. But people may have to explore farther and dig deeper to get what they need. Or they may have to substitute one material for another that has become too scarce. For example, aluminium may be used in place of copper for many purposes. While copper is scarce, deposits of bauxite and clay contain more aluminium than people can ever use.

Mineral fuels are different and can all be used up. The earth contains enough mineral fuels to last only one or two centuries. When these supplies run out, people may depend more on nuclear energy to power motor vehicles and factories and solar energy to heat homes. Even today, uranium and other nuclear fuels generate electricity. Such fuels will last for many centuries. Sunlight is already used to run the instruments in space satellites, and may someday be widely used to provide energy. See **Energy supply; Nuclear energy; Solar energy.**

Preserving the delicate balance of nature in biological resources appears to be the most difficult and important part of saving our natural resources. People have often upset this balance. For example, poor farming methods have ruined much farmland and left it barren. Each year, millions of metric tons of fertile topsoil that could produce good crops are washed away by rains. Chemicals sprayed on crops and washed off by rain sometimes end up in rivers and streams. Some of these chemicals kill the fish in the streams. Some entire species of birds and animals have been killed off by hunters.



Erosion is caused by climatic effects such as drought, frost, rain, sunshine, and wind. It is a natural process. It damages natural resources such as soil, trees, and plants, but inappropriate farming methods can encourage erosion, particularly in areas where large quantities of trees are cut down.

The world's great forests, and especially the tropical rainforests, are an important natural resource. They are diminishing as a result of logging and clearing. The loss of the rainforest puts at risk other biological resources, including many little-known or as yet undiscovered species. The loss may also be a threat to the world's atmosphere and climate. See **Greenhouse effect.**

Fumes from cars and trucks and smoke from factories poison the air. This *air pollution* in many cities kills trees and endangers human health. As more cars and factories are built, the problem gets worse. To correct these conditions, people will have to reduce the amount of pollution produced by factories and cars.

Even if natural resources are conserved and developed, the earth will be unable to provide enough food if the population increases too much. With much effort, the amount of land under cultivation could be doubled, and farms in many developing countries could produce three or four times as much as they now do. Scientists also believe people can get much more food from the sea. All this might increase the food supply to 5 or even 10 times what it now is. But at the present rate of increase, the world's population would double in 43 years.

If this rate of increase continued, the population would be 5 times as large in 100 years, and 26 times as large in 200 years.

Related articles in *World Book* include:

Air
Conservation
Developing country
Forest
Forestry
Game
Industry (Natural resources)
Mineral
Soil
United Nations University
Water
Wildlife conservation

Natural selection is a process in nature by which the organisms best suited to their environment are the ones most likely to leave offspring. This process has been called *survival of the fittest,* though a more accurate term would be *reproduction of the fittest.* The theory of natural selection was first explained in detail in the 1850's by the British naturalist Charles Darwin. He believed all plants and animals had *evolved*—that is, developed by changing over many generations—from a few common ancestors by means of natural selection. Plants and animals produce many offspring, but some of the young die before they can become parents. According to Darwin's theory, natural selection determines which members of a species die prematurely and which ones survive and reproduce.

The theory of natural selection is based on the great variation among even closely related individuals. In most cases, no two members of a species are exactly alike. Each has a unique combination of such traits as size, colour, and ability to withstand cold or other harsh conditions. Most of these traits are inherited.

Only a limited supply of food, water, and other necessities of life exists for all the organisms that are produced. Therefore, the organisms must constantly compete for these necessities. They also struggle against such dangers as being destroyed by animals that prey on them or by unfavourable weather. In any environment, some members of a species have combinations of traits that help them in the struggle for life. Other members have traits that are less suitable for that environment. The organisms with the favourable traits are most likely to survive, reproduce, and pass on those traits to their young. Organisms that are less able to compete are likely to die prematurely or to produce few or inferior offspring. As a result, the favourable traits replace the unfavourable ones in the species.

If the environment changes, different traits or combinations of traits may become favourable to survival, and the overall character of a species might change. In this way, a species adapts to its environment and avoids extinction. If two populations of a species live in different environments, they will probably develop differently. Eventually, they may differ so much that they become two separate species.

In 1858, Darwin and another British naturalist, Alfred Wallace, presented similar theories of natural selection. Many biologists rejected the idea at first. They incorrectly thought that the process of natural selection and evolution would eventually stop because a species would have used up all its possible variations. Since then, scientists have learned that the cells of every living thing have tiny structures called *genes,* which determine the organism's hereditary traits. An organism inherits a set of genes from each parent. Variations occur in part because genes for new traits are constantly being introduced into a species and shuffled among individuals by reproduction. See **Gene; Heredity** (Heredity and natural selection).

Virtually all biologists believe that natural selection is an important process in evolution. But some religious groups reject the theory because it conflicts with their beliefs about the creation of the world and all living things.

See also **Evolution; Darwin, Charles; Races, Human** (Natural selection); **Wallace, Alfred.**

Naturalism, in literature, is the attempt to apply scientific theory and methods to imaginative writing. Naturalists concentrate on the physical world to the exclusion of the supernatural. Naturalism thrived in the late 1800's and early 1900's, and has been most important in the novel and in drama.

Theory of naturalism. Naturalists have been the most uncompromising realists. They believe that knowledge is acquired through the senses, and that the function of the writer is to report accurately what he or she observes. The naturalist tries to be as objective as a laboratory scientist. In their theory of life, naturalists are more pessimistic than realists. The realist believes people can make moral choices, but the naturalist believes they cannot. Naturalists believe that everything a person does is determined by his heredity, or environment, or both. They try to show that people are trapped by one or both of these great forces over which they have no control.

In picturing people as trapped by their environment, the naturalist usually deals with the more degraded aspects of life. Characters in naturalistic literature are driven by their most basic urges. Their language is often coarse, their view of life hopeless, and their mood depressing. Yet in the best naturalistic works, there is a tone of compassion and even admiration for those characters who struggle against overwhelming odds.

Naturalism in fiction. The principles of naturalistic fiction were first stated by the French author Émile Zola in *The Experimental Novel* (1880). Zola argued that novelists should treat their material as scientists treat theirs. Before 1880, psychological and physiological studies such as Zola recommended had appeared in works by Honoré de Balzac, Jules and Edmond de Goncourt, Gustave Flaubert, and other French writers. Zola's books shocked English and American readers, but his theories and novels established naturalism as an important literary movement.

Naturalism became a significant influence on later writers particularly, since the 1890's, in the United States. Stephen Crane, Hamlin Garland, and Frank Norris were the first Americans consciously to adopt the naturalistic style. Most critics, however, consider Theodore Dreiser the best American naturalist. Dreiser's novel *An American Tragedy* (1925) is a moving account of a young man trapped by circumstance.

Naturalism in drama has the same goals as naturalism in fiction. A highly realistic setting provides a sense of environment overwhelming the characters. The staging, acting, and plots are realistic and simple. Everything focuses upon the hopeless, but often admirable, struggle of the characters against fate.

Zola also led the movement in drama with his adaptation of his novel *Thérèse Raquin* into a play in 1873. August Strindberg of Sweden and Gerhart Hauptmann of Germany are among the best European naturalistic playwrights. Strindberg's *The Father* (1887) and *Miss Julie* (1888) are violent studies of sexual relationships. *The Weavers* (1893) by Hauptmann, a grim portrait of a workers' revolt, set the style for German naturalism. Naturalism also appears in plays by Henrik Ibsen of Norway and Leo Tolstoy and Maxim Gorki of Russia.

In the United States, naturalism became most popular and important in the plays of Eugene O'Neill. Many of O'Neill's plays, especially the trilogy *Mourning Becomes Electra* (1931), have a depressing atmosphere and characters who lead sad lives.

Naturalism today has declined in influence, but its methods and its view of life are responsible for much of the imaginative power in today's fiction and drama. Excessive though naturalism may have been in its hopelessness and brutality, modern literature reveals life more honestly because of it.

Naturalist. See **Nature study** and its list of *Related articles.*

Nature Conservancy Council was a government-appointed body concerned with all aspects of nature conservation in the United Kingdom. In 1990 it was disbanded into three separate organizations. These are: the Countryside Council for Wales, English Nature, and Scottish Heritage. The Joint Nature Conservation Committee coordinates the activities of these three regional bodies. Under the 1990 Environmental Protection Act, these groups designate national nature reserves, notify sites of special scientific interest, and are responsible for the nomination of marine nature reserves.

These organizations provide advice to local authorities, landowners, government departments, and others whose activities affect the countryside. They seek to make people aware of the need for conservation and the part they can play in caring for the environment. They also carry out research into *ecology* (the relations between living things and their surroundings), and the effect of people's activities on wildlife.

Nature study means watching and learning about things in nature. Students of nature may go on hikes in the countryside to observe the birds or to look for wild flowers. In the city, nature lovers may visit gardens, museums, parks, and zoos to learn about the natural world. Many youth organizations have nature study programmes. Such organizations may sponsor outings or carry out special projects for the protection of the natural environment.

Careful observation is necessary in nature study. Many *naturalists* (students of nature) keep detailed records of their observations in the form of notes, sketches, or photographs. Some students of nature collect such things as flowers, insects, leaves, rocks, or shells. Naturalists have made many important contributions to our understanding of nature.

Related articles in ***World Book*** include:

Naturalists

Agassiz, Louis
Andrews, Roy C.
Asbjørnsen, Peter C.
Audubon, John J.
Beebe, William
Bewick, Thomas
Burroughs, John
Cuvier, Baron
Darwin, Charles R.
De Vries, Hugo
Fabre, Jean H.C.
Hudson, William H.
Lamarck, Chevalier de
Linnaeus, Carolus
Muir, John
Murray, Sir John
Wallace, Alfred R.

Some nature study subjects

Animal
Astronomy
Balance of nature
Bird
Botany
Butterfly
Conservation
Constellation
Desert
Earth
Fish
Flower
Forest
Forestry
Fruit
Gardening
Geology
Hobby
Insect
Lake
Leaf
Mountain
Ocean
Plant
River
Rock
Season
Seed
Star
Tree
Vegetable
Volcano
Water
Waterfall
Weather
Zoology

Other related articles

Aquarium
Botanical garden
Museum
National forest
National Park
Observatory
Park
Planetarium
Telescope
Terrarium
Zoo

Nature worship is a religious practice that has been followed by various cultures throughout history. It is based on the belief that nature is a god or a group of gods that can grant people favours and protect them from evil. Some peoples have worshipped all of nature in the form of one god or goddess. Others have worshipped specific natural forces, such as the sun or the winds. In most cases, a community has worshipped the parts of nature that are most important to the group's survival. For example, early people in some agricultural areas asked a rain god for rain to make their crops grow.

See also **Animism; May Day; Pantheism.**

Nauru is a small island country in the central Pacific Ocean. It has an area of only 21 square kilometres. Nauru is the third smallest country in the world. Only Vatican City and Monaco are smaller. Nauru is rich in *phosphates*—valuable chemical compounds used in making fertilizers. Phosphate exports earn a large part of the revenue of Nauru.

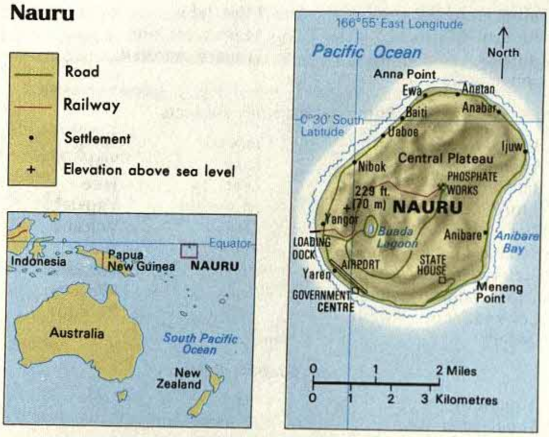
Nauru has no capital city. The main government offices are on the southwestern part of the island. The Australian dollar is Nauru's basic unit of currency. For a picture of the flag of Nauru, see **Flag** (picture: Flags of Asia and the Pacific).

Government. Nauru is a republic and a member of the Commonwealth of Nations. An 18-member Parliament makes the country's laws. Parliament members are elected by the people to three-year terms. All Nauruans who are 20 years old or older may vote. The Parliament elects a president to a three-year term. The president selects a Cabinet. The president and the Cabinet carry out the government's operations.

Land. Nauru, an oval-shaped coral island, lies about 65 kilometres south of the equator. Most of the island is a plateau, 61 metres high, which contains deposits of phosphates. Near the centre of the plateau is a lagoon surrounded by a small area of fertile land. Another belt of fertile land extends around the coast.

Most of the people live along the 19-kilometre coastline. In the past, the people raised their own food. Now, they import most of their food and other products they need. Nauru has a tropical climate that is cooled by

Nauru



trade winds. Temperatures range from 24 to 34 °C. About 200 centimetres of rain falls yearly.

People. About half of Nauru's population of 11,000 are Nauruans—people of mixed Polynesian, Micronesian, and Melanesian ancestry. They are Christians. Most of them speak both the Nauruan language and English. The rest of Nauru's people are from Kiribati, Tuvalu, Hong Kong, and Australia. They come for limited periods of time to help mine the phosphates.

The government provides Nauruans with modern homes at low rents, and 2 government hospitals and 11 clinics give them free medical care. The law requires Nauruan children between the ages of 6 and 17 to attend school. Nauru has five nursery schools, an elementary school, a high school, a Roman Catholic mission school, and a teacher training centre. The government pays the expenses of students who go to college in other countries.

Economy. Phosphates are Nauru's only important resource and the country's only export. A government-owned shipping company in Nauru serves many regions in the Pacific Ocean. A government-owned airline provides service to many Pacific areas. Nauru's government encourages such local industries as fishing and canoe building. Imported products include food, machinery, cars, furniture, shoes, and medicine. Nauru also imports water for its needs.

History. In 1798, Captain John Fearn, an English explorer, was the first European to visit Nauru. In 1888, Germany took over the island and administered it until 1914 when Australia took control. After World War I, Australia began to administer the island under a League of Nations mandate held also by the United Kingdom (UK), Australia, and New Zealand.

Japan seized Nauru during World War II. In 1945, Australian forces retook the island. In 1947, the United Nations (UN) provided for Australian control of the island under a trusteeship held also by the UK, Australia, and New Zealand. In 1964, Nauru began to work for independence and control of the phosphate industry. The UN granted Nauru independence in 1968. In 1970, the Nauruan government gained control of the phosphate industry. Since then, the government has used revenue from phosphate exports to build homes, schools, and hospitals. It has also saved much of the revenue to help support the Nauruan people after all the phosphates have been mined.

Nausea is a disagreeable sensation in the area of the stomach. It is often followed by vomiting. In nausea, the muscles of the stomach wall slow or stop their movement. In turn, digestion of the contents of the stomach slows or stops. This action can help prevent the body from absorbing a poisonous substance that has been swallowed. If vomiting takes place, most of the substance will be expelled.

Nausea also may result from many other causes, both

Young girls of the Pacific island of Nauru performing a traditional dance. A United Nations Trust Territory from 1947, Nauru became an independent republic in 1968.

mental and physical. Mental causes of nausea include unpleasant sights, disgusting odours, and severe anxiety. Physical causes include severe pain, obstruction or irritation of the digestive tract, excessive physical exercise, and unnatural stimulation of the *vestibular system,* the organs of balance of the inner ear. Nausea that results from disturbances of the vestibular system is called *travel sickness.* Nausea often accompanies pregnancy, especially in the mornings of the first three months.

Some poisonous substances cause nausea by stimulating nerve endings in the lining of the stomach or intestine. Other poisons cause nausea after being absorbed into the blood. The blood carries the poison to special cells in the *medulla,* the lower part of the brain stem. These cells create nausea by sending impulses to higher parts of the brain, where sensations are received. Various drugs are used to control certain types of nausea.

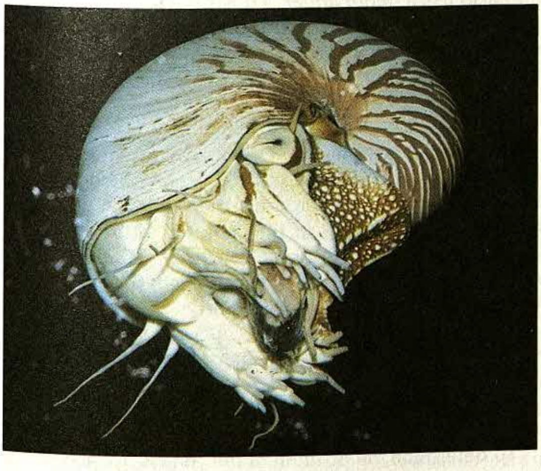
See also **Vomiting.**

Nautical mile. See **Knot; Mile.**

Nautical terms. See **Ship.**

Nautilus is a marine animal whose soft body is partly covered with a coiled shell. The nautilus belongs to the same class of animals as the squid and octopus. A nautilus shell contains about 30 chambers which are lined with a rainbow-coloured substance called *mother-of-pearl* or *nacre.* Because of this substance, the animal is often called a *pearly nautilus.* The nautilus lives at depths of 6 to 300 metres in the South Pacific and Indian oceans. It eats crabs and other crustaceans. About six species of nautilus are living today. At least 2,000 fossil forms are known.

The body of a full-grown nautilus is about the size of a person's fist. Its cone-shaped head is surrounded by about 90 short *tentacles* (feelers). As the animal grows, its shell develops in the form of a spiral. The nautilus adds a new chamber to its shell each time it outgrows its old one. Each new chamber is closed at the rear, so the animal always lives in the outermost chamber of its shell. The closed chambers behind the animal are filled with nitrogen and other gases. The *siphuncle,* a coiled, blood-filled tube that is enclosed in a limy covering, extends through all the chambers of the shell.



The chambered nautilus has a spiral shell. The animal adds a new, larger chamber to its shell each time it outgrows its old one. Its cone-shaped head is surrounded by short tentacles.

Scientific classification. The nautilus is in the phylum Mollusca. It belongs to the nautilus family, Nautilidae. The pearly nautilus is *Nautilus pompilius.*

See also **Argonaut; Shell** (Octopuses and squids; pictures: Nautilus shell).

Nautilus. See **Submarine** (Early submarines; Nuclear submarines).

Naval architect. See **Ship** (Designing).

Naval mutinies of 1797 were protests in England by seamen against bad conditions. Seamen's pay had not increased since the late 1600's, and was often years overdue. The men were badly fed and lived in crowded, unhealthy conditions. Harsh discipline resulted in men being flogged to death for minor offences. The mutinies took place at the Royal Naval anchorages at Spithead, near Portsmouth, and at the Nore, near Sheerness.

The Spithead Mutiny, in which the British fleet refused to put to sea, was a well-organized affair. It resulted in an Admiralty recommendation to Parliament for an increase in seamen's pay. The Mutiny at the Nore, which followed that at Spithead, was less well organized and more radical. The Admiralty starved out the Nore fleet. When it surrendered, 30 seamen were hanged.

Naval stores. In the days of wooden sailing ships, the term *naval stores* referred to tar and pitch. These two materials were essential for shipbuilding. Today, the term includes the rosin, turpentine, pitch, and tar products from pine and other resinous trees.

Navarino, Battle of. See **Greece** (History).

Nave. See **Basilica; Cathedral; Architecture** (table: Terms; Early Christian architecture).

Navel. See **Umbilical cord.**

Navel orange. See **Orange.**

Navigation is the process of determining a vehicle's position and directing its movement. Navigation is used chiefly to guide aeroplanes, ships, and spacecraft, but it also can be used for vehicles that travel on land. The word *navigate* comes from the Latin words *navis,* meaning *ship,* and *agere,* meaning *to drive.* Navigation involves many sciences, including astronomy, mathematics, and physics, and a variety of equipment.

Basic navigation aids include a *chart* and a *compass.* A chart shows the physical characteristics of an area and is used to plot a vehicle's course and position. An aeronautical chart provides such information as the location of airports and the height of mountains. An aeronautical chart also shows the location of radio transmitters that aid navigation. A nautical chart provides the depth of the water, the location of buoys and lighthouses, and other sailing information. A navigator uses either a *magnetic compass* or a *gyrocompass.* Most gyrocompasses are larger and heavier than magnetic compasses and so are used on large vehicles.

Vehicles also have such basic navigation aids as an extremely accurate timepiece called a *chronometer* and a device used to determine speed. The speed gauge of a plane is known as an *air-speed indicator.* The one on a ship is a *log,* and the speed gauge of a land vehicle is a *speedometer.*

There are five primary methods of navigation: (1) dead reckoning, (2) piloting, (3) celestial navigation, (4) electronic navigation, and (5) inertial guidance. A navigator uses one or a combination of these methods, depending on such factors as the type of vehicle and the weather.

Dead reckoning

Dead reckoning (DR) involves locating a vehicle's position by determining how far and in what direction it has travelled. This method is not extremely accurate. However, navigators generally use dead reckoning along with any of the other methods.

In dead reckoning, the navigator determines the vehicle's position in relation to its last *fix.* A fix is a vehicle's known position. Starting at the fix, the navigator draws a line on a chart that represents the direction and distance travelled by the vehicle. The vehicle's DR position is at the end of this line. The navigator determines the direction with a compass. The distance is calculated by multiplying the vehicle's speed by the time travelled.

Dead reckoning does not consider such factors as current, steering errors, or the wind. Any of these factors may cause a vehicle to be at a location other than the DR position calculated by the navigator. The navigator must then use a more accurate method to establish a new fix.

Dead reckoning helps the navigator keep track of a vehicle's position between fixes. It is also used to plot future positions and to estimate when the vehicle will arrive at its destination.

Some large ships use a device called a *dead reckoning tracer* to plot their position electronically. The tracer monitors the ship's gyrocompass and log to ascertain the direction and distance travelled. This information is automatically and continually drawn on a chart or displayed on dials.

Piloting

In piloting, a navigator finds the position of a vehicle in relation to one or more landmarks. An up-to-date chart is a necessary aid for piloting. The chart shows the positions of natural landmarks, including mountains and islands, and of such artificial landmarks as buildings, buoys, and lighthouses. Piloting involves determining a landmark's *bearing* (direction) and distance from the vehicle.

A bearing is determined by using a compass or a *pelorus.* A pelorus is a compasslike device that measures the bearing of a landmark in relation to a ship. This instrument has a circular face marked off in degrees and a *sight vane* that rotates above it. The navigator aims the sight vane at a landmark, and the bearing is shown on the face of the pelorus. A device called an *azimuth circle* can be attached to a compass and rotated like a sight vane to determine bearings. A hand compass can also be used.

The simplest method of piloting involves finding the bearings to two or more landmarks. A landmark's bearing is represented on a chart as a line called a *line of position.* The navigator determines the bearing of one landmark and draws a line of position from the landmark in the direction indicated by the compass or pelorus. The vehicle's position is somewhere along this line. The navigator then ascertains the bearing of another landmark and draws a second line of position. The vehicle's location is the point where the two lines cross.

A navigator plots a vehicle's course and position on a chart that shows the physical characteristics of an area.

Other methods of piloting include (1) observing the bearings of a single landmark at various intervals of time, and (2) observing when two landmarks lie on a single bearing.

Piloting can be used to navigate most types of vehicles. Ships use this method when entering or leaving ports, or when sailing close to land. Many small boats are piloted with only a chart and compass. Navigators may also use a *depth finder,* a device that measures the depth of the water. A navigator compares the depths indicated by this device with the depths shown on the chart.

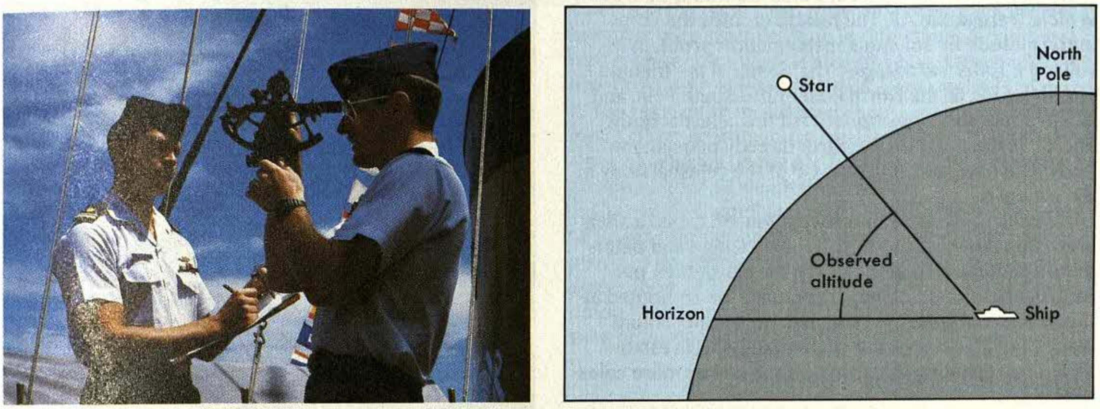
Celestial navigation

Celestial navigation is a method of determining a vehicle's location by observing certain celestial bodies—the sun, the moon, the stars, and the planets. A publication called an *almanac* lists the positions of these bodies at all times during the year. Celestial navigation uses *Greenwich Mean Time* (GMT), the time in Greenwich, England (see **Time** [Worldwide time zones]).

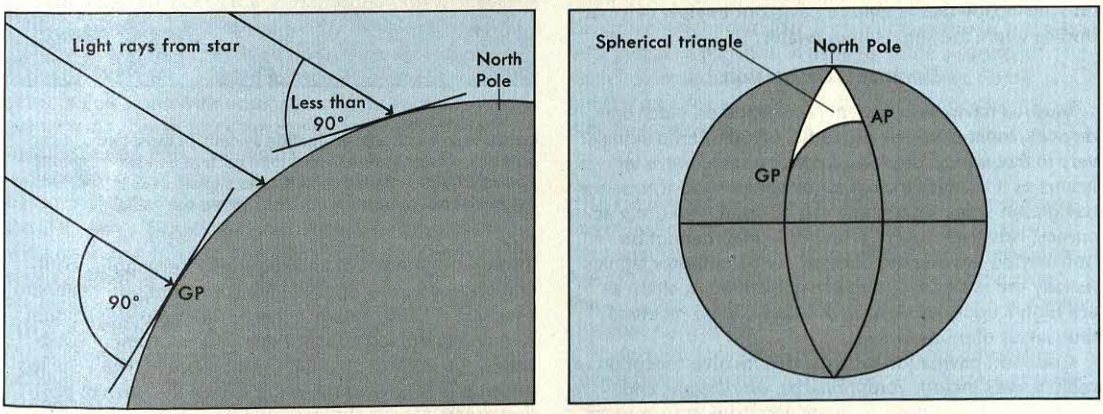
There are many variations of celestial navigation. In one common method, the navigator finds a vehicle's position in relation to an *assumed position* (AP). An AP is a point chosen by the navigator that is at or near the vehicle's dead reckoning position.

To determine the position of the vehicle, the navigator uses a *sextant.* This instrument measures the angular distance of a celestial body above the horizon. Such a measurement is called the *observed altitude* of the

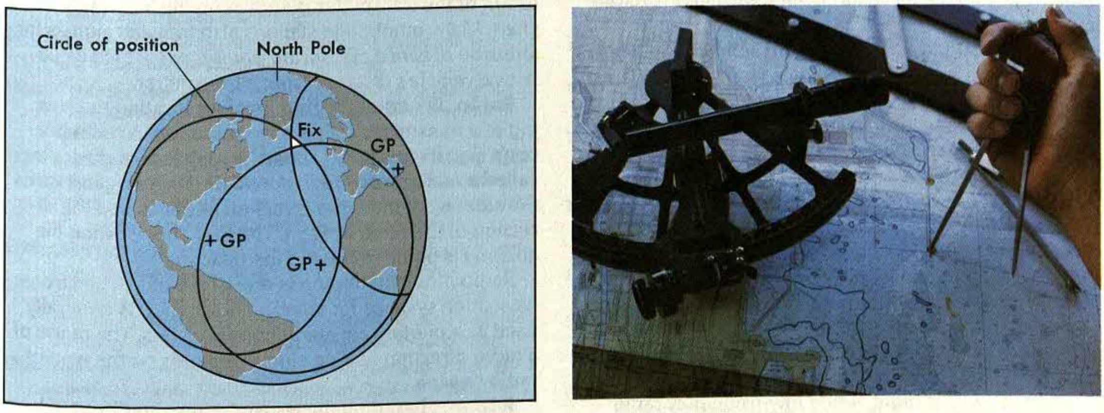
A common method of celestial navigation



To find a vehicle's position, a navigator first chooses an *assumed position* (AP). An AP is a point that is at or near the vehicle's estimated location. The navigator then uses an instrument called a *sextant, above left,* to measure the angular distance between the horizon and a star or other *celestial body.* This measurement is called the star's *observed altitude, above right.*



Light rays from the star strike various points on the earth at different angles, *above left.* At the point directly beneath the star, the rays intersect the earth at an angle of 90°. This point is called the star's *geographic position* (GP). The GP, AP, and North Pole are the points of a *spherical triangle, above right,* which the navigator uses in calculating the star's *computed altitude.*



Determining the fix. The computed and observed altitudes are used to place the vehicle on a *circle of position.* The GP of the star is the centre of the circle. Additional circles of position, involving observations of other stars, are then established, *above left,* to determine the vehicle's location, also known as its *fix.* The navigator marks this position on a chart, *above right.*

body. The navigator then calculates the *computed altitude,* which is what the body's altitude would be if the vehicle were at the AP. The navigator finds the computed altitude by solving a mathematical problem involving a *spherical triangle.* The points of the triangle are (1) the AP, (2) the North Pole or the South Pole, and (3) the *geographic position* (GP) of the celestial body. The GP is the point on the earth directly beneath the body. The navigator finds the GP of the celestial body in the almanac.

A special calculator or a navigation aid called a *sight reduction table* is used to solve the triangle and determine the computed altitude. The navigator then performs certain calculations to compare the computed altitude with the observed altitude. These calculations place the vehicle on a line of position. A fix is established by repeating the process with one or more celestial bodies.

For most ships, celestial navigation can be used only when the sky is clear. Celestial navigation can be used on aeroplanes and spacecraft at any time these vehicles fly above the clouds. Submarines have a special navigation periscope that enables a navigator to view celestial bodies while the ship is underwater.

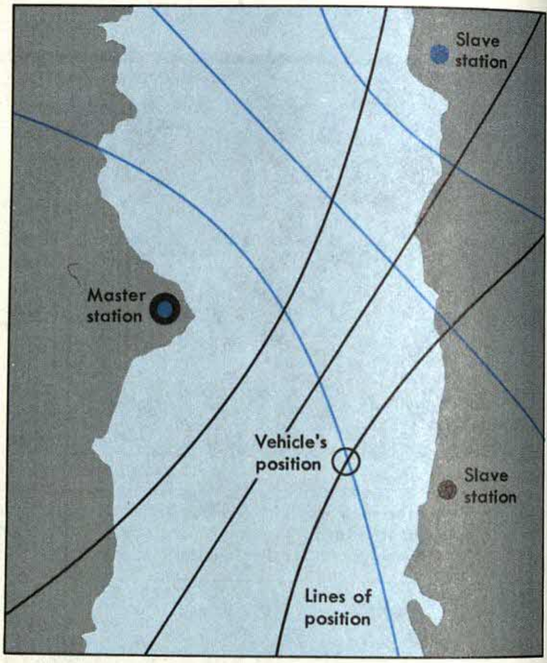
Electronic navigation

Various navigation systems are based on electronic devices, most of which use radio signals. Radio signals vary in *frequency,* the rate at which a radio wave vibrates as it travels through air or space. High-frequency navigation signals generally can be used with great accuracy. However, high frequency signals cannot be transmitted beyond the horizon. Low-frequency signals usually are not as accurate in establishing position as are high-frequency signals, but they can be received thousands of miles away.

Common navigation systems that involve reception of radio waves include *loran, omega, omnirange,* and *radio direction finding.* In many countries, transmitters for these navigation systems are based on land, and most are operated by governments. Other systems that use radio signals include *radar* and *satellite navigation.* Radar equipment is carried aboard a vehicle or based on land. In satellite navigation, the transmitter is based in space.

Loran is used to guide ships and some aeroplanes as they approach a country's coastline from the sea. The word *loran* stands for *lo*ng *r*ange *n*avigation. A loran system uses two types of stations called a *master station* and a *slave station.* Special equipment aboard a ship or a plane uses the low- or medium-frequency signals sent by these stations to establish a *loran line of position.* The location of a vehicle is at the point where the lines of position derived from two pairs of loran stations intersect on a chart. In most cases, a single master station is paired with each of two slave stations.

Some loran systems have a range of more than 1,600 kilometres during the day. Under certain atmospheric conditions, the signal can be received more than 4,800 kilometres away at night, when low-frequency radio waves travel farther. A position can be located within 0.4 kilometre. See **Loran.**



Loran is an electronic navigation system. In most cases, it consists of a *master station* paired with each of two *slave stations.* Special equipment on a vehicle uses signals from the stations to establish lines of position and thus locate the vehicle.

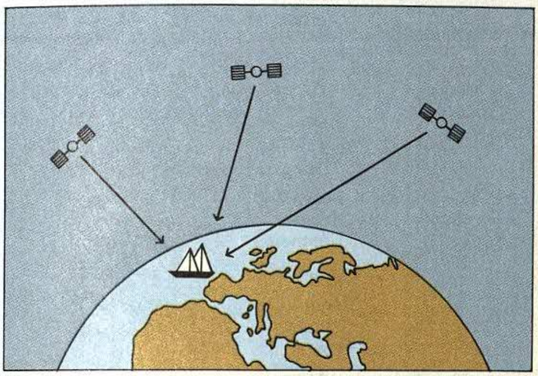
Omega is a worldwide navigation system for planes and ships. The system has eight transmitters located throughout the world and requires international cooperation to operate. Special electronic equipment aboard a vehicle receives and processes the radio signals sent by any two omega transmitters. This equipment establishes two lines of position for the vehicle. The vehicle's position is at or near the point where the lines of position cross.

Omnirange is a short-range navigation system for aircraft flying over land. A special receiver electronically traces the signal of an omnirange transmitter to determine the bearing of the transmitter from a plane. The location of the transmitter is shown on the aeronautical chart. Many omnirange stations also transmit signals for airborne *distance measuring equipment,* which calculates a vehicle's distance from a transmitter.

Radio direction finding involves locating the bearing of a transmitter called a *radio beacon.* A radio beacon's signal is received aboard a vehicle by a device called a *radio direction finder* (RDF). The navigator turns the antenna of the radio direction finder to find the direction of the radio beacon. The RDF shows when the antenna is pointing toward the beacon.

Radio direction finding is one of the oldest electronic navigation systems for aircraft and ships. It is generally used as a piloting aid along coastal waters. The range of a radio direction finding signal depends on the type of radio beacon.

Radar is based on the transmission of radio signals toward an object and the reception of the signals that are reflected from the object. The return signals create an image on a radar screen, which shows the direction and distance of the object from the vehicle.



The Navstar Global Positioning System consists of 24 orbiting satellites that broadcast their positions. A surface vehicle, such as a ship, can establish its location by computing its distance from three satellites. An aircraft must receive broadcasts from four satellites to find its position.

Radar has many uses in navigation. It helps a navigator carry out a piloting operation by locating the vehicle's position in relation to landmarks at night or in bad weather. Radar also is used to locate obstructions and to prevent collisions with other vehicles. In addition, navigators use radar to track the positions of aeroplanes, missiles, ships, and spaceships.

Satellite navigation. There are several satellite-based navigation systems. Probably the best known is the U.S. Navy's TRANSIT system, which began worldwide operation in 1964. The TRANSIT system consists of seven operating satellites and several spares that circle the earth in widely spaced orbits. A computerized receiver on a vehicle fixes its position by analysing the Doppler shift of the signals broadcast by any TRANSIT satellite as it passes overhead (see **Doppler effect**).

Another worldwide satellite system, the Navstar Global Positioning System (GPS), became fully operational in 1995. It consists of 21 satellites and three spares that circle the earth in six different orbits. Each satellite broadcasts its exact position and the time. A computerized receiver on a vehicle analyses how long it takes the broadcast from at least three different satellites to reach it. The receiver then determines its location by calculating its distance from these satellites. The GPS enables all types of vehicles on the earth and in the air to find their position under all weather conditions.

GLONASS, a satellite navigation system similar to the GPS, was established by the Soviet Union. This system provides positioning information for land navigation across most of Europe. After the break-up of the Soviet Union in 1991, control of GLONASS passed to an alliance of former Soviet republics, then to Russia.

Inertial guidance

Inertial guidance involves the use of a computer and a device called an *inertial navigator*. An inertial navigator constantly monitors changes in the vehicle's motion and sends this information to the computer. The computer uses these changes, plus the distance and direction travelled, to calculate the vehicle's course and position. Inertial navigation is used to guide a variety of vehicles, including aircraft and submarines. Some guided missiles also use inertial guidance systems. See **Inertial guidance.**

History

In ancient times, sailors navigated by observing various celestial bodies and constellations and by studying the seasonal directions of the wind. During the Middle Ages (A.D. 400's-1500's), navigators drew simple charts that included wind directions for different seasons, plus compass directions.

Many of today's navigation instruments developed from crude equipment used hundreds of years ago. For example, the first compass consisted of a magnetized piece of metal on a straw. The straw floated in a con-

Important dates in navigation

1100?-1200? Chinese and Mediterranean navigators used magnetic compasses to guide ships.

1519-1522 Ferdinand Magellan, a Portuguese navigator, led the first expedition to sail around the world.

1569 Gerardus Mercator, a Flemish geographer, invented the *Mercator map,* with which a navigator can determine direction and distance.

1730 John Hadley, an English mathematician, and Thomas Godfrey, an American astronomer and mathematician, independently invented the *sextant.* This device measures the angle between a celestial body and the horizon.

1735 John Harrison, an English clockmaker, made the first accurate *chronometer*—a device for measuring time.

1767 Nevil Maskelyne, an English astronomer, compiled the first *nautical almanac.* A nautical almanac is used to guide a ship by determining the positions of celestial bodies.

1802 Nathaniel Bowditch, an American mathematician and astronomer, wrote *The New American Practical Navigator.* This book explains the principles of navigation and methods of using them.

1842 Lieutenant Matthew F. Maury of the United States Navy charted the direction of winds and ocean currents. This information is used in *piloting,* a method of navigation.

1896 Guglielmo Marconi, an Italian inventor and electrical engineer, sent the first ship-to-shore radio signal.

1908 Herman Anschütz-Kämpfe, a German engineer, invented the gyroscopic compass.

1910 J. A. D. McCurdy, a Canadian aviator, sent the first aeroplane-to-ground messages.

1933 P. V. H. Weems, an American navigator, compiled the first *air almanac,* used in guiding a plane by means of the positions of celestial bodies.

1939-1945 During World War II, British and American scientists made significant contributions to the development of improved radar equipment.

1942 The United States built the first *loran* stations, which broadcast special radio signals used in navigation.

1945-1950 American scientists developed a highly accurate *inertial guidance system,* which guides a vehicle without using outside signals.

1964 The United States Navy's Navigation Satellite System (TRANSIT) began daily operation.

1978 The U.S. government launched the first satellite of a global navigation system called *Navstar.*

1982 The U.S. government's omega navigation system became fully operational with the completion of its last station.

The astrolabe was used by navigators before the invention of the sextant to measure the angle of stars above the horizon.

tainer of water. The sextant developed from the *astrolabe* and the *octant,* two early instruments for measuring the angle between a celestial body and the horizon. An astrolabe consisted of a disc, plus a sight that turned on a pivot. An octant had the same arrangement of mirrors as a sextant.

In the 1700's, James Cook, a British navigator, became the first person to use modern celestial navigation methods. Cook used these techniques in making several voyages to the Pacific Ocean.

The development of radio, followed by its use on ships and aeroplanes in the early 1900's, marked the start of electronic navigation. During World War II (1939-1945), German scientists developed navigation systems to guide V-1 and V-2 rockets. On the Allied side, scientists in the United Kingdom and the United States made important advances in radar technology (see **Radar**).

Satellite navigation began in 1960, when the United States launched a satellite called *TRANSIT 1B,* but the TRANSIT system did not begin daily operation until 1964. In the 1970's, the United States began to launch the first several satellites of the Navstar Global Positioning System (GPS). During the 1980's, development of the Global Positioning System continued. The system became fully operational in 1995, when the last of its satellites began operation.

Related articles in ***World Book*** include:

Navigation instruments

Aeroplane (Flying an aeroplane)
Astrolabe
Chronometer
Compass
Fathometer
Gyrocompass
Gyroscope
Inclinometer
Log
Loran
Plumb line
Protractor
Radar
Radio
Sextant
Shoran
Sonar

Famous navigators

Cabral, Pedro Álvares
Columbus, Christopher
Cook, James
Da Gama, Vasco
Dias, Bartolomeu
Drake, Sir Francis
Henry the Navigator
Magellan, Ferdinand
Quiros, Pedro Fernandez De

Navigation aids

Aeroplane (Flight navigation)
Almanac
Beacon
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Map
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Other related articles

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Knot
Latitude
Longitude
Mercator, Gerardus
Meridian
North Star
Phoenicia
Sailing
Time
Trade wind
Vikings

Navigation acts were several laws passed in the 1600's by the English Parliament. The purpose of the laws was to protect English trade. In 1645, Parliament passed a law that forbade the importation of whale oil into England in vessels other than English, or in ships that were not manned by English sailors.

The act known officially as the First Navigation Act was passed by Parliament in 1651. It was aimed against the English colonies and the Dutch, who were enjoying most of the carrying trade between the West Indies and Europe. The act provided that no products from any foreign country might be shipped into England in any but English-built ships manned by English crews. The First Navigation Act was not strictly enforced.

The Dutch continued to carry on their trade with the colonies. As a result, the English Parliament passed other trade laws in 1660, 1663, and 1672. The act of 1660 required that all the tobacco from the colonies must be brought to England. The act of 1663 (Second Navigation Act) declared that almost all goods imported into the colonies must be landed in England first. In 1672, an act was passed requiring that goods had to be shipped to England before they could pass from one of the American colonies to another.

Before 1761, 29 acts had been passed in restraint of colonial trade. These included one law that prohibited the import of molasses and sugar. But the Americans vigorously opposed the restrictions on commerce. This opposition was one of the main causes of the American Revolution. The British Parliament, in 1849, repealed all the Navigation laws.

Navratilova, Martina (1956-), became one of the world's top women tennis players. From 1973 until her retirement in 1994, she won a record 167 singles championships. She became noted for her strong serve, powerful backhand and forehand shots, and aggressive style of play.

Navratilova was born in Prague, in what is now the Czech Republic. She defected to the United States in 1975 and became a U.S. citizen in 1981. Navratilova won a record nine women's singles titles in the All-England (Wimbledon) Championships in 1978, 1979, 1982, 1983, 1984, 1985, 1986, 1987, and 1990. She won the Australian Open in 1981, 1983, and 1985, the French Open in 1982 and 1984, and the United States Championships in 1983, 1984, 1986, and 1987. Navratilova also ranks as a leading doubles player.

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A naval task force consists of a temporary unit of ships formed to carry out an operation. In this British task force, a V/STOL aircraft carrier leads a group of smaller Royal Navy warships.

Navy

Navy is the branch of a nation's armed forces that consists of warships and support ships, their crews, and land bases and their personnel. Many of the world's navies also have an air force. Some navies include combat forces called *marines,* who are trained to fight in the air and on land.

Most nations that have a coastline have a navy. But the world's navies differ greatly in size, in fighting strength, and in the types of ships and aircraft that they have. Smaller navies consist mainly of warships called *small combatants,* such as patrol boats, missile boats, and minesweepers. The main task of a small navy is to defend its nation's coastline. Larger navies also have major warships, such as aircraft carriers, submarines, and frigates. These warships can operate far out at sea without returning to port for weeks or months. Nations use large navies to control the sea and, during times of war, to attack enemy shores.

The United States and Russia have the world's largest navies. Other countries with large navies include China, France, India, and the United Kingdom (UK). For centuries, the most powerful nations were often those with the strongest navies. The development of aircraft and missiles in the 1900's reduced the importance of seagoing forces. Nevertheless, navies still have tremendous military and political value. Warships are flexible in operation, and they can travel the seas freely. International law allows ships to sail within 22.2 kilometres of any country's coast without permission. Thus, a group of warships can serve as a temporary military base. More importantly, ships can carry out their mission independent of foreign land bases.

The role of navies

Nations use their navies in many different roles. A navy's role depends on its size and composition, and whether the nation is at war or at peace.

Peacetime roles. When a nation is at peace, it may show political support by sending its ships to an ally's port or by training with an ally's navy. Navies may also help deliver food, medicine, and other humanitarian aid to war-torn countries or to areas struck by a natural disaster. In addition, nations may use their navies to collect *intelligence* (information about potential enemies).

Sometimes, navies perform limited military operations during peacetime. For example, in the late 1980's in the Persian Gulf, the UK's Royal Navy cleared mines and U.S. warships escorted oil tankers to protect them from attack during the war between Iran and Iraq. This was a military action, even though the UK and the United States were not directly involved in the war.

Wartime roles. During a war, the primary role of a small navy is to defend its nation's coastline against enemies. Large navies have two principal wartime roles: (1) controlling the sea and (2) providing a base from which to launch attacks against the shore.

Controlling the sea means that a navy takes over specific areas of the ocean to ensure the safe passage of its own ships and to deny passage to enemy ships. Control of the sea involves defending ships against attack. It also may involve blockading enemy land bases so that enemy ships and aircraft cannot use them. A navy may control some areas of the sea by laying *naval mines* (explosive devices in the water). Naval mines can damage or destroy ships that try to pass over them.

A nation with a large navy also has the power to attack targets on land from the sea. Modern warships can launch attacks from positions far out at sea using missiles and aircraft. Navies may also launch *amphibious assaults*—invasions of enemy coastal areas by the combined action of land, sea, and air forces.

The organization of navies

Every navy has a shore-based branch and a seagoing branch. The shore-based branch includes headquarters, communications stations, airfields, shipyards, maintenance facilities, supply stations, naval schools, and their personnel. The seagoing branch, usually called the *fleet,* consists of a navy's ships, submarines, ship-based aircraft, and their crews. The organization of a fleet varies with the size, mission, and location of the navy. The U.S. Navy, for example, has separate fleets in the Atlantic and Pacific oceans. France has Atlantic and Mediterranean fleets. India's navy operates one fleet on India's western coast and a second fleet on its eastern coast.

Because ships are flexible in their operation, they can be organized in many combinations for different purposes. In most fleets, each ship is assigned to a permanent administrative unit called a *group, squadron,* or *division.* Large fleets may also organize their ships into *task forces.* These are temporary groupings of ships formed to carry out a particular task. A task force may consist of one or more than a dozen ships, depending on the task. In the U.S. Navy, task forces are called *battle groups* when they contain one or more aircraft carriers.

Detmar Modes, Bundesministerium Verteidigung

Navy personnel may be assigned to ships or bases on shore. This German naval officer serves aboard a small ship. From the *bridge* (navigational centre), he watches a nearby auxiliary ship.

Ships and aircraft

The world's navies operate many types of ships, ranging from huge aircraft carriers to small patrol boats. Navies also use many kinds of aircraft.

Mou Jianwei, Xinhua News Agency

Chinese sailors on the deck of a destroyer prepare a guided missile for launching. The large Chinese Navy operates mostly in coastal waters.

Aircraft carriers are the largest warships ever built. Carriers serve as mobile bases for many kinds of aircraft. Some carriers are designed for *conventional aircraft,* which would normally require a long runway. Conventional aircraft are launched from a carrier deck with the aid of a *catapult.* When the aircraft land, a device called a *tail hook* lowered from the rear of the plane catches one of the steel cables stretched across the deck. Only the Brazilian, French, Russian, and U.S. navies had conventional aircraft carriers in the mid-1990's.

Other carriers can serve as a base only for *V/STOL aircraft,* which take off vertically or from a short runway. V/STOL stands for *v*ertical/*s*hort *t*ake-*o*ff and *l*anding. Several navies have V/STOL carriers. Helicopters fly from both types of carriers.

Most carriers are armed with guns and missiles for short-range defence, but they depend on their aircraft and other warships for protection. Russian carriers are more heavily armed than carriers in other fleets.

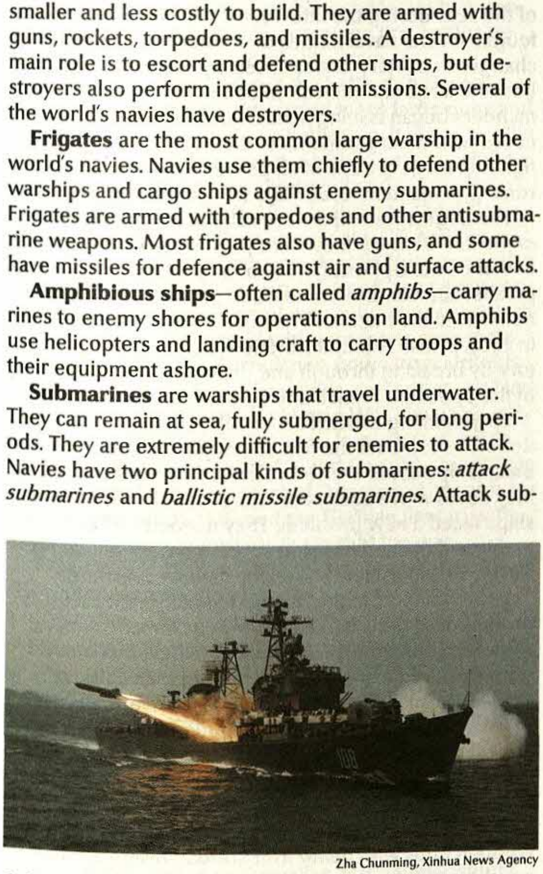
Cruisers are the next largest warships. Navies use cruisers primarily to defend aircraft carriers against air and submarine attacks. Cruisers are armed with missiles, rockets, and torpedoes. Some cruisers also carry powerful long-range missiles for attacking targets on land. Only France, Italy, Peru, Russia, and the United States had cruisers in the mid-1990's.

Destroyers are similar to cruisers, but they are smaller and less costly to build. They are armed with guns, rockets, torpedoes, and missiles. A destroyer's main role is to escort and defend other ships, but destroyers also perform independent missions. Several of the world's navies have destroyers.

Frigates are the most common large warship in the world's navies. Navies use them chiefly to defend other warships and cargo ships against enemy submarines. Frigates are armed with torpedoes and other antisubmarine weapons. Most frigates also have guns, and some have missiles for defence against air and surface attacks.

Amphibious ships—often called *amphibs*—carry marines to enemy shores for operations on land. Amphibs use helicopters and landing craft to carry troops and their equipment ashore.

Submarines are warships that travel underwater. They can remain at sea, fully submerged, for long periods. They are extremely difficult for enemies to attack. Navies have two principal kinds of submarines: *attack submarines* and *ballistic missile submarines.* Attack submarines carry torpedoes and missiles. They primarily attack enemy surface ships and submarines. More than 40 navies have attack submarines. Ballistic missile submarines carry long-range ballistic missiles with nuclear warheads for attacking targets on shore. Only the navies of China, France, Russia, the UK, and the United States have ballistic missile submarines.



Zha Chunming, Xinhua News Agency

A destroyer from the Chinese fleet tests a guided missile for use against enemy ships, aircraft, and shore targets. Many types of warships may be armed with missiles.

Auxiliary ships are noncombatant ships, most of which support warships. *Underway replenishment* (UNREP) ships carry fuel, food, weapons, ammunition, and other supplies for warships at sea. Other auxiliary ships include supply and repair ships called *tenders,* hospital ships, tankers, salvage ships, and tugs.

Small combatants include missile and torpedo boats, minesweepers, and patrol boats. Small combatants operate mostly in coastal waters. Missile and torpedo boats have limited seagoing ability, but they carry powerful weapons for attacking larger ships. Minesweepers locate and destroy enemy mines. Patrol boats guard coastal waters.

Aircraft play a major role in modern naval operations. Navies use many types of aircraft, including fighter, attack, antisubmarine, cargo, and *reconnaissance* (observation) planes; and helicopters.

Major navies of the world

A powerful navy is modern, well trained, and can fight effectively. The world's largest navies belong to the United States, Russia, China, the United Kingdom, France, and India. A navy's size does not necessarily reflect its fighting strength, however. For example, one aircraft carrier can provide as much striking power as several cruisers or submarines. In addition, advanced weapons can give a small navy major striking power.

The United States had more than 185 surface warships in the early 1990's, including 12 conventional aircraft carriers. The carriers, 7 of which were nuclear powered, were the backbone of the U.S. fleet. In addition to surface ships, the U.S. Navy operated about 100 nuclear-powered submarines. Approximately 500,000 men and women served in the U.S. Navy. Another 180,000 belonged to the Marine Corps, a separate branch of the Department of the Navy.

Russia took control of most of the massive Soviet Navy after the Soviet Union broke apart in late 1991. Since then, Russia has taken many ships and submarines out of service because they cost too much to operate. Despite these reductions, the Russian Navy is still large, and most of its ships are modern.

The submarine is the most important ship in the Russian fleet. The Russian Navy had about 250 submarines in the early 1990's, far more than any other navy. About 150 were nuclear powered. Russia also had more than 190 surface warships. The Russian Navy had about 320,000 men, including marines.

China has a large navy, but its ships are old and have spent little time training at sea. Thus, the effectiveness of the Chinese Navy has been limited. China's fleet operates mostly in coastal waters. During the early 1990's, China had about 50 surface warships, plus about 1,000 small combatants. China also operated about 45 submarines, only 6 of which were nuclear powered. Approximately 260,000 people, including marines, served in the Chinese Navy.

France has a small navy, but it is modern, well trained, and effective. France had about 40 surface warships in the early 1990's, including 2 conventional aircraft carriers. France also had 17 submarines, 9 of which were nuclear powered. About 65,000 people served in the French Navy, including marines.

The United Kingdom has a small but effective navy. The navy of the United Kingdom, called the Royal Navy, operated about 45 surface warships in the early 1990's. The Royal Navy also had about 20 submarines, more than half of which were nuclear powered. About 62,000 people, including marines, were in the Royal Navy.

India enlarged its navy during the 1980's as part of a major arms build-up. By the early 1990's, India had nearly 30 surface warships and 15 diesel-powered submarines. However, lack of funding forced India to cut back its naval building programme and to limit time spent training at sea. About 55,000 people, including marines, served in the Indian Navy.

The history of navies

Ancient navies. By about 3000 B.C., the Egyptians were using small seagoing ships for military purposes. Between 2000 and 1000 B.C., the Greeks began building long, wooden ships called *galleys.* Galleys were propelled chiefly by oars, but most also had sails. Ancient Mediterranean civilizations used galleys to guard their coastlines and trading ships. Ancient galleys had pointed bows to ram other ships. Later, crews used *catapults* (weapons that resembled giant slingshots) to throw stones, hot coals, and pitch onto enemy ships.

In 483 B.C., the Greek city-state of Athens began to build a large fleet of galleys to defend itself against invaders from Persia. Athens soon became the dominant naval power in the Mediterranean Sea. Athens defeated the Persian fleet near the island of Salamis in 480 B.C. in the first naval battle for which an extensive record exists.

In 31 B.C., the fleets of two rival Roman leaders, Mark Antony and Gaius Octavian, fought a battle off Actium in western Greece. Antony was allied with Cleopatra, the queen of Egypt, and commanded their joint fleets. Octavian's fleet won the battle. He later became Emperor Augustus of Rome. Rome reigned as the supreme naval power in the Mediterranean for the next 250 years.

Navies in the Middle Ages. From the A.D. 700's to about 1100, bold Scandinavian sailors, now known as Vikings, raided coastal and river settlements throughout western Europe. In the late 800's, the English king Alfred the Great built a large fleet of galley warships to defend his country against Viking raiders.

During the 1200's, Europeans began to build ships with large, deep *hulls* (main bodies). Deep-hulled ships were faster and could travel more easily on the high seas than long, low galleys. Sails rather than oars became the principal means of propulsion, though some ships still used oars when there was no wind.

Most navies of the Middle Ages followed a standard battle plan. Attacking warships sailed alongside enemy ships and hurled rocks and flaming chemicals at them. Attackers then tried to ram or board enemy ships. After boarding, the crews fought hand-to-hand using swords, hatchets, and, later, guns. Some historians believe navies first used cannons during the 1300's. But naval guns did not come into wide use until the 1500's.

Between 1405 and 1433, a Chinese fleet, led by Admiral Cheng Ho, made a series of seven expeditions to the Indian Ocean, the Middle East, and the eastern coast of Africa. These voyages established China as the unchallenged naval power in Asia for the first half of the 1400's. China's naval supremacy ended after leaders who disapproved of contact with foreigners took control.

The beginning of modern navies. The Italian city of Venice was the major sea power in the Mediterranean during the late Middle Ages. By 1400, Venice had a fleet of about 3,000 galleys. The Ottoman Empire, based in what is now Turkey, ranked as Venice's chief naval rival. In 1571, Venice, Spain, and their allies destroyed most of the Ottoman fleet in a battle off Lepanto in Greece. This was the last major battle between oar-driven galleys.

During the 1500's, Spain and England competed for control of the Atlantic Ocean. Both countries built ships called *galleons.* Galleons were large, high sailing ships with three masts. In the late 1500's, English galleons began harassing Spanish galleons carrying gold and silver from the Americas. In response, Spain built a fleet called the Armada. In 1588, this fleet tried to invade England. But England's galleons were smaller and easier to manoeuvre than Spain's, and English crews were better trained. The English crushed the Armada, and England dominated the Atlantic for the next 300 years.

The Netherlands competed with England for control of the seas during the mid-1600's. The two countries fought several naval battles that brought important changes in military tactics at sea. By this time, fleets had become large and difficult to command. Naval commanders began issuing instructions before a battle to coordinate the movements of their ships during the fighting. Large groups of ships were divided into squadrons. Commanders used flags to signal to other ships.

The largest warships were called *battleships* or *ships of the line* because they were positioned in the main line of battle. Opposing lines of battleships sailed on parallel courses and bombarded each other with cannon fire. In the Battle of Trafalgar, off the coast of Spain in 1805, British Admiral Horatio Nelson won a major victory by breaking through and disrupting the battle line of the opposing French and Spanish navies.

Engineering advances. In 1814, American inventor Robert Fulton built the first steam-powered warship. Steamships could cruise faster than sailing ships, and they could move against or without wind. But steamships faced a new problem. They needed fuel and had to depend on land bases to supply coal for refuelling. Navies had to establish fuelling stations overseas.

Improvements in the range, reliability, and accuracy of shipboard guns had a tremendous impact on naval warfare. During the 1820's, inventors developed naval guns that fired explosive shells rather than solid balls. In 1853, Russian ships fired the first explosive shells used in naval battle, destroying the wooden ships of the opposing Ottoman fleet during the Crimean War. In this war, Russia fought the allied forces of Britain, France, Sardinia, and the Ottoman Empire.

In the mid-1800's, shipbuilders began covering wooden hulls with heavy iron armour. Inventors developed rotating turrets so that naval guns could be fired in almost any direction without turning the ship. As the range and accuracy of guns increased, ships fought at

Detail from *The Battle of Lepanto* (late 1500's), an oil painting on canvas by Antonio Vicentino; Doges' Palace, Venice (SCALA/Art Resource)

In the Battle of Lepanto, near Greece in 1571, the navies of Venice, Spain, and their allies defeated the Ottoman fleet. Lepanto was the last major battle between oar-driven galleys.

greater distances. Crews no longer boarded enemy ships and fought hand-to-hand, as in the sailing era.

In 1862, during the American Civil War, the Union's *Monitor* fought the South's *Merrimack* (then named the *Virginia*) in the channel of Hampton Roads in Chesapeake Bay. Neither ship was sunk. But this battle is famous because it was the first battle between two iron-armoured ships. It was also one of the first battles between ships powered entirely by steam.

In 1906, the UK completed the battleship *Dreadnought.* The *Dreadnought* carried more large guns and was faster than any previous battleship. It made all other battleships out of date, and it pushed Germany and the UK into a race of modern shipbuilding.

World War I began in 1914. In the war, the Allies, who included France, Italy, Russia, the UK, and the United States, fought Germany, Austria-Hungary, and other Central Powers. The war featured two new weapons that revolutionized naval war: submarines and aeroplanes. Submarines armed with torpedoes sank many enemy surface ships. Aeroplanes, flown from airfields ashore, attacked ships, submarines, and targets on land.

Most naval battles during World War I involved only small numbers of ships. The war's largest naval battle occurred in 1916, when the UK and Germany fought the Battle of Jutland, off the coast of Denmark. Although the UK lost more ships, it forced the German fleet to withdraw and remain in port for the rest of the war.

When World War I ended in 1918, the UK, Japan, and the United States were engaged in costly shipbuilding programmes. After extensive negotiations, these and other nations agreed to limit warship construction. The Treaty of Versailles, which ended military action against Germany, barred Germany from building a large navy. But Germany violated the treaty by secretly building submarines for other countries. When German dictator Adolf Hitler rose to power in the early 1930's, he ordered the construction of a large navy. Japan and the Soviet Union also began building major fleets in the 1930's.

World War II began in Europe in 1939. In that war, Germany, Italy, Japan, and smaller Axis nations fought the Allies, who included Canada, China, the Soviet Union, the UK, and the United States. Naval combat broke out in the Atlantic in 1939, when German warships began attacking UK ships. Germany's goal was to cut off the UK's supply of food and war materials. The UK sank most of Germany's surface ships, forcing Germany to resort to submarine warfare. The Allies fought German submarines with planes, antisubmarine ships, radar, sonar, and underwater bombs called *depth charges.* In addition, the Allies were able to intercept and decode German radio messages, which helped them predict the movement of enemy submarines.

Naval combat began in the Pacific Ocean on Dec. 7, 1941. That day, Japanese bombers flying from six aircraft carriers made a surprise attack on the U.S. Pacific Fleet at anchor in Pearl Harbor in Hawaii. The Japanese sank or heavily damaged five U.S. battleships. But all of the U.S. Navy's aircraft carriers survived because none were then in Pearl Harbor. After the attack, aircraft carriers became the principal warship of the U.S. Navy.

The Battle of the Coral Sea, in May 1942, was the first naval battle fought entirely by carrier-based aircraft. Opposing Japanese and U.S. warships did not fire a single shot at an enemy ship. The Battle of Midway in June 1942 was the turning point for naval war in the Pacific. In this battle, the U.S. Navy sank four Japanese aircraft carriers and one cruiser. The Battle for Leyte Gulf in the Philippines, in October 1944, was one of the largest naval battles in history. This series of actions involved about 280 Japanese and U.S. warships. The battle eliminated Japan as a major naval power.

By the time Japan surrendered in 1945 and World War II ended, only the United States and the UK still had major navies. The U.S. fleet was much larger than the rest of the world's seagoing forces combined.

Navies during the Cold War. The Cold War was a period of intense rivalry that developed after World War II between Communist and non-Communist countries. During this period, many countries carried out naval building programmes. Many small navies were modernized with the addition of submarines, missiles, and other advanced weapons. The Soviet Union began a drive to enlarge and modernize its fleet in the late 1940's.

After World War II, aviation experts predicted that aircraft carrying nuclear bombs would be the principal weapon in future military conflicts. As a result, the U.S. Navy concentrated on building aircraft that could fly from large carriers and carry nuclear bombs.

The Korean War (1950-1953) proved, however, that conventional naval forces were still vital to modern conflicts. In this war, the United States and other members of the United Nations aided South Korea against North Korea, which was backed by China and the Soviet Union. Airpower was not the deciding factor in ending the war, and neither side used nuclear weapons. During the war, the U.S. Navy launched carrier-based air attacks, made amphibious landings, and used shipboard guns to bombard enemy coastal targets.

In 1954, the U.S. launched the world's first nuclear-powered ship, the submarine *Nautilus.* The first Soviet nuclear submarine was completed about five years later. The first nuclear-powered surface warships were the U.S. aircraft carrier *Enterprise* and the cruiser *Long Beach,* both completed in 1961. By the mid-1960's, the Soviet Union and the United States had submarines with ballistic missiles carrying nuclear warheads.

The world's navies were involved in numerous conflicts during the Cold War period. For example, in 1962, the U.S. Navy blockaded Cuba to force the Soviets to remove missiles and aircraft they had brought to the island. The U.S. Navy saw extensive combat in the Vietnam War after the United States became heavily involved in the war in 1965. The U.S. Navy also played a major role in the Persian Gulf War in 1991. In 1982, the UK's Royal Navy battled Argentina for control of the Falkland Islands in the South Atlantic Ocean. The Royal Navy was victorious, proving that it could fight against modern weapons at great distances from the United Kingdom.

Navies after the Cold War. The Cold War ended in the early 1990's, after the Soviet Union broke apart and democratic reforms took place in Eastern Europe.

Many countries, including Russia, the United Kingdom, and the United States, began reducing their navies. Older ships were cut up for scrap metal, newer ships were placed in reserve, and fewer new ships were built. Both Russia and the United States began reducing their fleets of ballistic missile submarines. However, some smaller navies, including those of France, India, and Israel, continued to build and modernize their fleets. Several of the former Soviet republics, especially Ukraine, began to build their own navies in the 1990's.

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Questions

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Navy Jack is a flag of the United States Navy. It has 50 white stars on a blue background. It looks like the blue and white corner portion of the U.S. flag, a picture of which appears in the *World Book* **Flag** article.

Nawaz Sharif (1949-) served as prime minister of Pakistan from 1990 to 1993. He was appointed after his party, the Islamic Democratic Alliance, gained a landslide victory in a national election. His declared policy was to abandon traditional feuds and parochial loyalties. He also aimed to work for national integration, industrialization, and reduced dependence on foreign aid. Nawaz Sharif was born in Lahore to a Muslim family. He gained a law degree from the Punjab University Law College at Lahore. He joined the Punjab cabinet as finance minister in 1981. From 1985 to 1990, he served as chief minister of the Punjab.

In 1993, a political struggle developed between President Ghulam Ishaq Khan and Nawaz Sharif. In April, the president dismissed Nawaz Sharif, but in May the Supreme Court reinstated him as prime minister. Finally, in July both men resigned from office.

Nazarbayev, Nursultan (1940-), was elected president of Kazakhstan in December 1991. Formerly a republic of the Soviet Union, Kazakhstan declared its independence shortly after the election.

As president, he has worked to replace Kazakhstan's traditional government-controlled economy with one that promotes free enterprise. His government has sold some state-owned factories and farms to private citizens. Nazarbayev has opposed a movement to split Kazakhstan into two countries, one inhabited by its Kazakh people and the other by its Russian people.

Nazarbayev was born near Almaty. He joined the Communist Party in 1962 and graduated from the Technical University at Qaraghandy Metallurgical Combine in 1967. From 1984 to 1989, Nazarbayev served as prime minister of the republic of Kazakhstan. He was first secretary of the Kazakh Communist Party from 1989 to 1991 and president of the Kazakh Supreme Soviet (legislature) from 1990 to 1991. He left the Communist Party in 1991 as the Soviet Communist system was falling apart.

Nazareth (pop. 45,600) is a town in northern Israel. For location, see **Israel** (political map). It was the home of Jesus Christ during His early youth. The town was in the Roman province of Galilee (see **Galilee**).

The Old Testament does not mention Nazareth. Nathanael in the New Testament expressed the attitude of the times about the village when he said, "Can there any good thing come out of Nazareth?" (John 1: 46).

Nazareth remained insignificant for many years after the time of Christ. But pilgrims visited the town about A.D. 600, and a large basilica was built. The Arabs captured the city in the 600's. The Crusaders built several churches there, but the Ottomans, who were Muslims, forced Christians to leave in 1517.

A new town of Nazareth stands on the site of the old town. The population of Nazareth today is far more than its population in Biblical times. The Latin Church of the Annunciation, completed in 1730, now rises where some people think the home of Mary, the mother of Jesus, stood. Since the 1700's, religious denominations have built churches and monasteries in Nazareth.

Nazism was a political movement—and later a form of government—that developed in Germany during the 1920's. The Nazis, led by the dictator Adolf Hitler, controlled Germany from 1933 to 1945. *Nazism* also describes any governmental system or political beliefs resembling those of Hitler's Germany. The word is also spelled *Naziism.*

Nazism was a *fascist* movement—that is, it tightly restricted personal freedom but permitted private ownership of property. The Nazis called for aggressive nationalism, militarism, and the expansion of Germany's borders. They glorified the Germans and other northern European peoples, whom they called *Aryans.* They claimed that Jews, Slavs, and other minority groups were inferior. Nazism opposed democracy, Communism, socialism, and other political systems that favoured or claimed to favour equality.

The birth of Nazism. Germany experienced political and economic crises after its humiliating defeat in World War I (1914-1918). A democratic government had replaced the monarchy that had long ruled the country. But the nation suffered from severe inflation and unemployment after the war ended. Many Germans lacked faith in the new government and began to turn to political groups that called for extreme changes.

One of these organizations was the German Workers' Party, a small discussion group in Munich. Hitler joined this group in 1919 and quickly gained control. He changed its name to the National Socialist German Workers' Party in 1920. *Nazi* stands for the first word in the German name of the party.

Hitler's aims were primarily nationalistic, but he also promised social revolution in order to win support from the masses. The Nazi Party grew rapidly in the postwar crisis. The military supported Hitler's ideas of discipline, order, and military conquest. The middle classes and farmers were attracted by the promise of social reform. Wealthy industrialists joined to fight Communism. By 1923, the Nazi Party had 17,000 members.

The rise to power. Nazism did not gain wide support until the Great Depression, a worldwide business slump, began in 1929. Discontented Germans then turned to Nazism in increasing numbers. Nazism promised economic help, political power, and national glory.

In the elections of 1932, the Nazis emerged as the strongest party in Germany. On Jan. 30, 1933, Hitler became *chancellor* (prime minister). He quickly moved toward dictatorship, outlawing civil liberties and all political parties except the Nazi Party. The Nazis took over the press, the radio, and the school system. In time, they established a *totalitarian state* (a government that permits no opposition). They organized a powerful secret police force called the *Gestapo* and set up concentration camps for anyone suspected of opposing Nazism. Jews and members of other minority groups were also imprisoned in these camps, where the Germans either killed them or used them for forced labour.

Expansion, war, and collapse. Hitler and his followers hoped to make the Nazi state a world empire. In 1938, they began to carry out their plans. German forces invaded Austria in 1938 and Czechoslovakia the next year. The Nazis attacked Poland later in 1939, and World War II began.

The Nazis also started a campaign to murder all European Jews. Hitler called this plan the "final solution." About 6 million Jews died by firing squad, in gas chambers, or by other methods. About 5 million others, including Gypsies, Slavs, Poles, and political opponents of the Nazis, were also killed. These mass murders later became known as the *Holocaust* (see **Holocaust**). The Allies defeated Germany in 1945, and the Nazi government collapsed.

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Jews (Beginnings of Nazi persecution; The Holocaust)
Mengele, Josef
Nuremberg Trials
Speer, Albert
Swastika
Wiesenthal, Simon
World War II

N.B.C. See **Chemical-biological-radiological warfare.**

N'Djamena (pop. 511,700) is the capital and largest city of Chad. It lies near the southwest border of the country where the Chari and Logone rivers meet. For location, see **Chad** (map).

N'Djamena is a trade and export centre for farm products of Chad. The city has little industry, but it has several hotels, a very busy market, and an international airport. Most of the city's people live in *adobe* houses (see **Adobe**).

French troops captured N'Djamena from black Africans in 1900 and named the town Fort-Lamy. They ruled the city and the rest of Chad until 1960. In 1973, the city was renamed N'Djamena. In 1979, 1980, and 1982, a civil war caused massive destruction in N'Djamena.

Neagh, Lough. See **Lough Neagh.**

Neale, John Mason (1818-1866), an English hymn writer and historian, translated many ancient Greek and Latin hymn and anthem texts. His translations include "Art Thou Weary?," "Jerusalem the Golden," "O Come, O Come Emmanuel," and "Christian, Dost Thou See Them?." Neale also wrote books on the medieval Eastern Church and its music. He was born in London.

Neanderthal man was a type of prehistoric human being who lived in parts of Europe, Asia, and Africa from about 100,000 to 35,000 years ago. Many scientists classify Neanderthal man as an early subspecies of *Homo sapiens* (wise human being). However, other scientists do not consider Neanderthals as direct ancestors of modern human beings. The word *Neanderthal* comes from the Neander Gorge near Düsseldorf, Germany. The first Neanderthal fossils were found there in 1856. Similar fossils have been found at over 40 sites.

Scientists long thought of Neanderthals as being stooped. But the fossils show that Neanderthals stood about 155 centimetres tall and walked fully erect. They had heavy bones, slightly curved limbs, big brow ridges, and powerful teeth. Their brain was as large as that of modern people, but they seem to have relied more on their physical strength than on skilful use of their hands or on inventive use of tools. But animal bones found with the human fossils show that the Neanderthals were successful hunters in the subarctic environments of Europe. They lived in simple temporary shelters when following the animal herds and sometimes also in caves. At least some Neanderthals buried their dead with great care.

See also **Prehistoric people** (Primitive human beings).

Neap tide. See **Tide** (High tides and low tides; diagram: Causes of sea tides).

Near East is a name given to a region that includes a part of Asia from the Mediterranean Sea to the eastern boundary of Iran, plus part of northeastern Africa. The British and French first called this region the Near East because it lay nearer to London and Paris than the Far East lay. Today, this region is usually called the Middle East (see **Middle East**).

Nearsightedness. See **Myopia.**

Neath (pop. 64,100) is a local government district in West Glamorgan, Wales. It is an extensive, mainly industrial borough centred on the town of Neath. Coal mining, oil refining, and the production of aluminium wire and vehicle parts are important industries. Neath has a ruined abbey dating from 1129 and a castle built in the 1000's. The Vale of Neath has some beautiful scenery.

See also **Glamorgan.**

Nebraska (pop. 1,584,617) is a state in the Midwestern region of the United States. It is a leading farming area. The state's chief crop is maize. Maize is called *corn* there, and Nebraska's nickname is the *Cornhusker State.* The name *Nebraska* comes from the Oto Indian word *nebrathka.*

Omaha, a centre for the insurance industry, ranks as Nebraska's largest city. Lincoln, which is the state capital, is the second largest city.

Nebraska covers 200,350 square kilometres. The land rises in a series of rolling plateaus from east to west. The lowest elevation in Nebraska is 256 metres, in the southeastern corner of the state. The highest elevation is 1,654 metres, along the far western border.

Nebraska has two major land regions. The Fertile Dissected Till Plains cover about the eastern fifth of the state. The Great Plains comprise the rest of Nebraska. Sand hills rise in the centre of this region. Temperatures in the state average 24° C in July and $-5°$ C in January.

Farms and ranches take up 95 per cent of the land—a higher percentage than in any other U.S. state. Farm products next in importance after maize are beef cattle, pigs, hay, and soybeans.

Nebraska's two major land regions are fertile plains. Farms and ranches account for 95 per cent of the land.

Service industries employ nearly three-fourths of the state's workers. Wholesale and retail trade is the largest employer in the state. Financial activities are important in Omaha, a national centre of the insurance industry.

Food processing is by far Nebraska's leading manufacturing industry. The operation of feed mills and meat-packing plants are major food-processing activities. Machinery is the second most important manufactured product.

European explorers encountered several Indian tribes in the Nebraska region. More tribes moved there as whites drove them from their homes in the East.

In 1682, France claimed a large region that included present-day Nebraska. The United States purchased this region in 1803. Beginning in 1862, settlers poured into the territory to claim small farms called *homesteads.* Nebraska became the 37th U.S. state in 1867.

In 1934, Nebraska became the only U.S. state to adopt a *unicameral* (one-house) state legislature. Many farms in Nebraska went out of business during a national farm crisis in the 1980's.

See also **Omaha.**

Nebuchadnezzar was the name of two kings of Babylon.

Nebuchadnezzar I (ruled 1124-1103 B.C.) was the greatest king of the second Isin dynasty, which followed the Kassite kings of Babylonia. He won fame by freeing Babylonia from Elamite control and by extending Babylonian rule over Elam, a country north of the Persian Gulf. Nebuchadnezzar's account of the Elamite battles is a fascinating document of ancient Babylonia.

Nebuchadnezzar II (ruled 605-562 B.C.) was the king of Babylonia about whom both the Old Testament and Babylonian sources have much to tell. He captured Jerusalem in 587 or 586 B.C., and destroyed the city. This battle ended the Judean kingdom. Nebuchadnezzar seized some Jews, and sent them to Babylon. The Old Testament tells of Nebuchadnezzar's spells of madness, when he would imagine himself an ox and would go out in the fields and eat grass.

Nebuchadnezzar was the son of Nabopolassar. He became king after his father's death in 605 B.C. Under Nebuchadnezzar's rule, Babylon became one of the most magnificent cities of the ancient world. In his own records, he rarely mentioned his military activities, but wrote of his building projects and his attention to the gods of Babylonia. Nebuchadnezzar probably built the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World (see **Seven Wonders of the Ancient World** [with picture]).

See also **Babylon; Babylonia; Daniel, Book of.**

Nebula is a cloud of dust particles and gases in space. The term *nebula* comes from the Latin word for *cloud.* Early astronomers also used the term for distant galaxies outside the earth's galaxy, the Milky Way. Such galaxies, called *extragalactic nebulae,* looked like hazy patches of light among the stars. But modern telescopes showed that extragalactic nebulae are actually systems of stars similar to the Milky Way.

Today, most astronomers use the term *nebulae* only for the clouds of dust and gases in the Milky Way and other galaxies. They classify these masses into two general types: *diffuse nebulae* and *planetary nebulae.* Both types are also called *gaseous nebulae.*

Diffuse nebulae are the larger of the two types. Some contain enough dust and gases to form as many as 100,000 stars the size of the sun. A diffuse nebula may occur near an extremely hot, bright star. The intense ultraviolet light from the star energizes the gas atoms of the nebula and enables the mass to emit light. Such a diffuse nebula is called an *emission nebula.*

Astronomers believe some emission nebulae are places where new stars are forming. Gravity causes a portion of a nebula's dust and gases to contract into a much smaller and denser mass. Pressure and temperature build up within the mass as contraction continues through millions of years. In time, the mass becomes hot enough to shine—and forms a new star.

A diffuse nebula also may occur near a cool star. In this case, the ultraviolet light from the star is too weak to make the nebula's gas atoms give off light. But the dust particles in the nebula reflect the starlight. This kind of diffuse nebula is called a *reflection nebula.*

If a diffuse nebula occurs in an area that has no nearby stars, it neither emits nor reflects enough light to be visible. In fact, its dust particles blot out the light from the stars behind them. Astronomers call such a diffuse nebula a *dark nebula.*

Planetary nebulae are ball-like clouds of dust and gases that surround certain stars. They form when a star begins to collapse and throw off a part of its outer gaseous envelope. When viewed through a small telescope, this type of nebula appears to have a flat, rounded surface like that of a planet. Because of this similarity, early astronomers called these nebulae *planetary nebulae.*

See also **Astronomy** (pictures: The Great Nebula; Optical telescopes); **Galaxy; Milky Way.**

The Great Nebula in the constellation Orion is a huge cloud of dust and gas. Its bright central area is shown above.

Nebular hypothesis is a theory about the origin of the solar system. Pierre Simon Laplace, a French astronomer and mathematician, formulated the theory in the late 1700's. According to Laplace, the solar system developed from a huge, extremely hot, rotating *nebula,* a cloud of dust particles and gases. The nebula cooled and contracted, leaving behind successive rings of matter as it became smaller. These rings, in turn, cooled and condensed, forming the planets. The remaining central core of the nebula became the sun.

Many of Laplace's ideas have been greatly modified by new discoveries. However, most astronomers believe the solar system did develop from a nebula.

See also **Earth** (How the earth began); **Laplace, Marquis de; Nebula.**

Neck. See **Skeleton; Giraffe** (diagram); **Throat.**

Necker, Jacques (1732-1804), was a statesman in France under King Louis XVI. When he was appointed French finance minister in 1777, the nation had an unbalanced treasury. The situation grew worse after France joined the American Revolution. Necker, a noted banker, borrowed heavily, and kept things going without increasing taxes. This only postponed trouble. He angered court circles by publishing, for the first time, a statement showing how taxes were spent and how much money actually went into the pockets of court favourites. He resigned in 1781.

Necker was recalled in 1788, after less able successors had brought France close to bankruptcy. He proved too cautious and indecisive to provide the leadership that might have prevented the French Revolution. On July 11, 1789, the king suddenly dismissed Necker, but was forced to take him back, by public demand. Necker again resigned in 1790.

He was born in Geneva, Switzerland. His daughter, Madame de Staël, was a French writer (see **Staël, Madame de**).

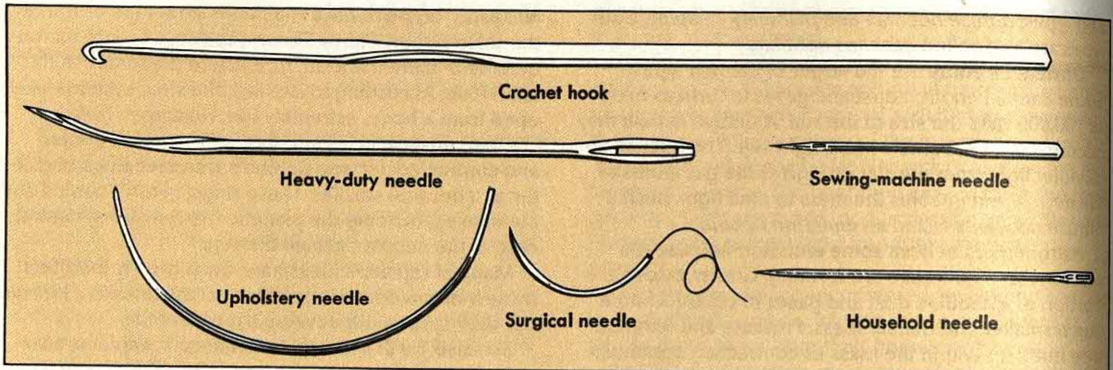
Necklace. See **Jewellery; Pearl** (Matching pearls).

Necktie, or tie, is a band of material or a bow that is worn around the neck. The *four-in-hand* (slip-knot) and *bow* ties worn today have been about the same style since they were first worn in the 1870's.

Neckties originated in the neck cloths that men folded and wrapped around their necks, with ribbon tied over them to hold the ends in place. In the 1700's, men wore a whalebone *stock.* They fastened it at the back with a strap or buckle, and tied it in front with a bow or knot. The *cravats* of the 1600's and 1700's were often frilly and lace-trimmed. By the mid-1800's, narrow string ties, knotted bow ties, and ascot ties had replaced the more elaborate cravat. Around 1870, the wider four-in-hand became popular for general wear, the white bow tie for evening wear, the black string tie for formal wear, and the soft windsor tie for sportswear. In the 1900's, formal black bow ties appeared. Striped neckties also became popular.

Necrology is a record of deaths, especially one kept by a church. Usually it shows the day, month, and year of the death. A necrology may be a list of people who have died within a certain time. It also may be an obituary notice.

Necromancy is a term taken from two Greek words meaning *corpse* and *divination.* It is the belief that the future can be discovered by communication with the



Different kinds of needles are made for special purposes. For example, a crochet hook has a hook to catch the thread. A heavy-duty needle is used to sew thick canvas or cloth for sails. Surgical needles are manufactured with thread attached to them for easy use in an operating room.

spirits of the dead. Necromancy was a common belief in early times.

Necropolis is a Greek word which means *city of the dead,* that is, a cemetery. Archaeologists and historians usually call the cemetery of an ancient city a *necropolis.*

Archaeologists have found large and well-known necropolises in Egypt, near such ancient cities as Memphis and Thebes. The tomb of Tutankhamen in the Valley of the Kings, near Luxor, is one of hundreds of tombs in the huge necropolis there (see **Tutankhamen; Valley of the Kings**). A necropolis also surrounds the pyramids at Giza. Another necropolis, dating from the Bronze Age, is at Hallstatt, Austria. Many necropolises have also been found in South America. One at Paracas, an archaeological site in Peru, dates back to the days before the Inca ruled there.

Ancient peoples often buried tools, weapons, and personal belongings with the dead. Sometimes they also carved or painted religious texts, information about the dead, and scenes from everyday life. Archaeologists and historians have learned much about ancient civilizations from necropolises.

Necrosis is the death of a group of body cells and tissues due to some disease or external cause. Necrosis can be caused by physical or chemical injury or by cutting off the blood supply to part of the body.

See also **Death** (Medical aspects of death).

Nectar is a sugary liquid produced by many flowers. Insects fly from flower to flower feeding on nectar. The nectar glands are usually at the bottom of the flower, and the insect has to brush past the pollen to reach them. It carries this pollen from one plant to another. Bees gather nectar, and change it to honey. See also **Bee** (Making honey).

Nectar was the drink of the gods in Greek mythology. They drank out of cups brought to them by Hebe and Ganymede. Nectar was probably like sweet red wine. It was drunk with ambrosia, the food of the gods. Nectar and ambrosia gave youth and immortality to those who took them. See also **Ambrosia; Ganymede; Hebe.**

Nectarine is a variety of peach with smooth skin. Nectarines usually have a richer, reddish-yellow colour than peaches, and a slightly more delicate flavour. Both nectarines and peaches belong to the same species and originated in China at least 2,500 years ago. The nectarine, like the peach, is mainly cultivated in warm temperate areas, particularly in places with a Mediterranean climate. It can also be grown further north in sheltered areas. On poor soils, the plants may be grafted onto hardier rootstocks such as peach/almond *hybrids* (cross breeds).

Scientific classification. The nectarine belongs to the peach species *Prunus persica.* It is *P. persica* var. *nectarina.*

See also **Peach.**

Needle is a simple-looking tool, with a fine point at one end and a tiny eye at the other. But needles are not easy to make. Each needle passes through the hands of nearly 20 workers and undergoes at least 20 processes.

Sewing needles are made from coils of steel wire. These coils are cut into pieces long enough for two needles. The pieces are then heated to a dull red and rolled on a flat steel plate to straighten them. The wires are pointed at each end on a grindstone. While they are being ground down to points, they are held by a device which makes them turn all the time they are touching the grindstone. This makes the points fine and even.

The nectarine is a fruit that resembles a peach. The fruit has a smooth skin and encloses a single large seed.

Only one end of the piece of wire is pointed at a time. After the ends are pointed, the centre section of the wire pieces is stamped by a machine. This makes a flat place for the eyes. Next, the two eyes are punched in the middle of each piece of wire by another machine. Now each piece of wire has become a double needle. A piece of wire is now run through the eyes. The needles are then cut apart, leaving the needles hanging on the wire. Next, the heads, or eye ends, are rounded and smoothed. Finally, the needles are *tempered* (toughened), and polished, sorted, and packed.

Special needles are made for special uses. Sewing-machine needles are made with the eye near the point. These needles also have a groove on one side, which acts as a guide for the thread that goes through the needle's eye.

A sewing needle for people with poor vision has the eye split so that the needle can be threaded through the top. A *crochet hook* is a type of needle with a hook at the end. The thread is caught in the hook instead of going through an eye. Upholstery sewing needles and surgical needles are curved.

See also **Sewing.**

Needleleaf tree. See **Tree.**

Needlepoint is a form of embroidery in which stitches are sewn through spaces or squares of an open-mesh fabric called the *canvas.* It is used to make clothing, pictures, purses, upholstery, and many other items. Needlepoint was once known as *tapestry.*

The pattern may be painted or printed on the canvas. The sewer uses a blunt-ended tapestry needle and a variety of soft threads. They include cotton embroidery, crewel, knitting or Persian yarns, and sometimes leather strips or ribbon. The stitches create a flat design on the surface of the mesh.

The basic needlepoint stitch is the *cross stitch.* It occupies a square area over an intersection of the canvas mesh. Other stitches create various patterns and designs. These stitches include the slanting *basketweave* and *knotted* styles. Needlepoint may be worked in fine thread and small stitches called *petit point,* or in large stitches known as *gros point.*

See also **Embroidery; Lace; Petit point.**

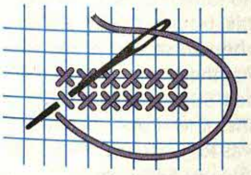
Needlework. See **Crocheting; Embroidery; Knitting; Lace; Needlepoint; Petit point; Quilt; Sampler; Sewing.**

Neel, Louis Boyd (1905-1981), founded and conducted the Boyd Neel Orchestra, one of Europe's leading string orchestras. He founded the orchestra in 1932. Musicians admired his interpretations of orchestral works by Bach and Handel. Neel also conducted several major British orchestras. From 1953 to 1971, he was Dean of the Royal Conservatory of Music in Toronto, Canada. He was born in London.

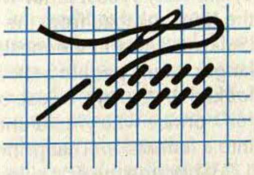
Nefertiti was an ancient Egyptian queen, the wife of Akhenaton, a *pharaoh* (king) who ruled from 1367 to 1350 B.C. Akhenaton was the first pharaoh to preach *monotheism* (belief in one god). Nefertiti was a firm supporter of Akhenaton's teachings and assisted him in the new religious ceremonies. The reign of Akhenaton and Nefertiti is called the *Amarna Revolution* because of the many changes in art, religion, and social practices they made.

Some popular needlepoint stitches

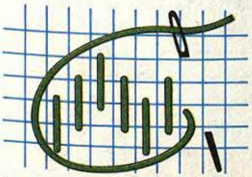
There are dozens of needlepoint stitches, ranging from simple techniques to complicated ones. The photograph on the right below shows four popular stitches. They are sewn onto a piece of open-mesh fabric called the *canvas.* The drawings on the left show these four stitches and how to make each one. The same colour thread was used for each kind of stitch in the photo and the drawings.



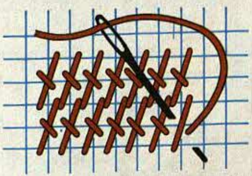
Cross stitches consist of two separate stitches. The first is sewn from lower right to upper left. The second is sewn from lower left to upper right, crossing the first stitch.



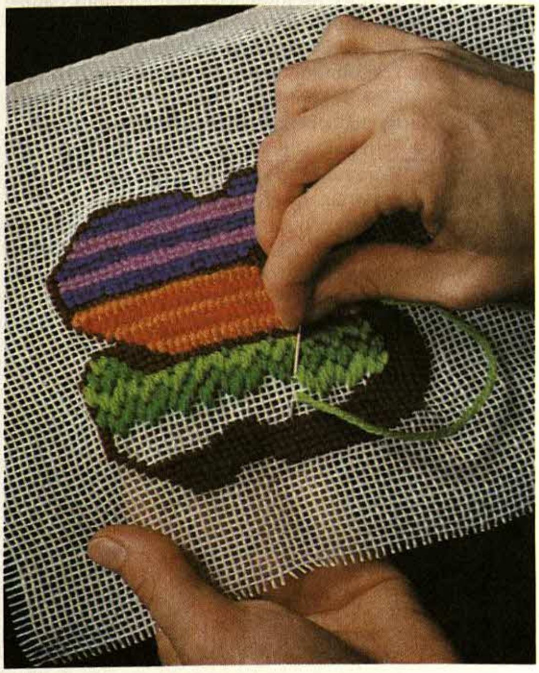
Tent stitches are the most popular needlepoint stitches. This slanting stitch is sewn from lower left to upper right. The smallest tent stitches are also called *petit point.*



Bargello, or *Florentine embroidery,* consists of straight vertical stitches. The sewer can vary the lengths and arrangement of the stitches to create zigzag designs.



Knotted stitches consist of two stitches. One is a diagonal stitch sewn from lower left to upper right. The other is a reversed tent stitch. It ties the diagonal stitch to the canvas.



Amarna is a site where Akhenaton built a large new capital called Akhetaton, where mural paintings and carvings illustrated the new styles and beliefs.

Nefertiti is the subject of several sculptured portraits. A limestone head of the queen in the Berlin Museum and an unfinished head of her in the Egyptian Museum in Cairo are among the best known of these portraits.

See also **Egypt, Ancient** (The New Kingdom).

Painted limestone sculpture (about 1355 B.C.) by an unknown Egyptian artist; Egyptian Section, Staatliche Museen, Berlin

Nefertiti

Negative number. See **Algebra** (Positive and negative numbers).

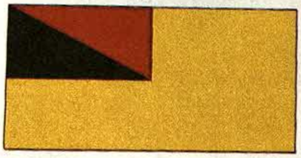
Negeri Sembilan, also spelled Negri Sembilan, is a state in Peninsular Malaysia. Its name is Malay for *the nine states.* It shares borders with Selangor to the north, Pahang to the east, and Johor and Melaka to the south. There is a short coastline to the west where it meets the Strait of Malacca.

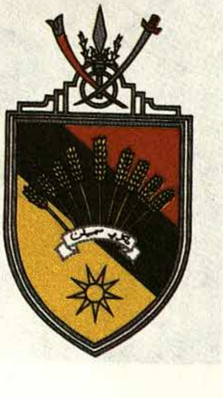
People and government. About 46 per cent of the population are Malay, 36 per cent are Chinese, and about 19 per cent are Indian. Many Malays in Negeri Sembilan are the descendants of Minangkabau immigrants who first came to the area from Sumatra in the 1400's.

The head of state of Negeri Sembilan is a *yang dipertuan besar* who serves as *sultan* (ruler). The state assembly has 28 seats. See also **Malaysia, Government of.**

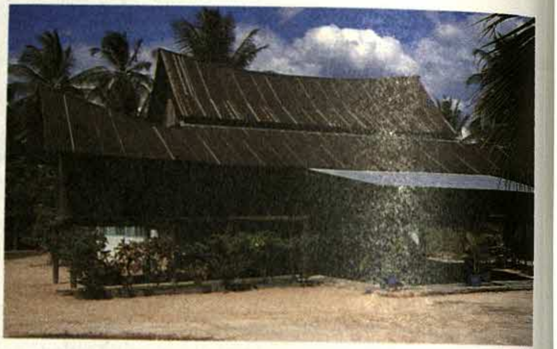
Economy. Negeri Sembilan is an important area for the cultivation of rubber. Other major commercial crops are forest products, and palm oil. Negeri Sembilan has also become a centre for industrial development, especially electronics, food processing, textiles, and ceramic tiles. Negeri Sembilan has the advantage of being close to both Kuala Lumpur and the major seaport of Port Kelang.

Land. A large part of Negeri Sembilan is mountainous. The southern part of the Main Range *(Banjaran Titiwangsa)* runs from north to south through the state. A number of rivers drain east from this range, and flow through the low-lying country in the east before they meet in the headwaters of the Pahang River. To the west of the Main Range, the land remains largely hilly almost as far as the coast. A number of small rivers drain this part of the state. Most of the short coastline is rocky and sandy, with minor capes at Port Dickson and Cape Rachado.





Negeri Sembilan's flag has three colours, representing the ruler, the four *undang* (chiefs), and the people. The state emblem, *right,* has nine heads of rice and a nine-point star, representing the original nine states.



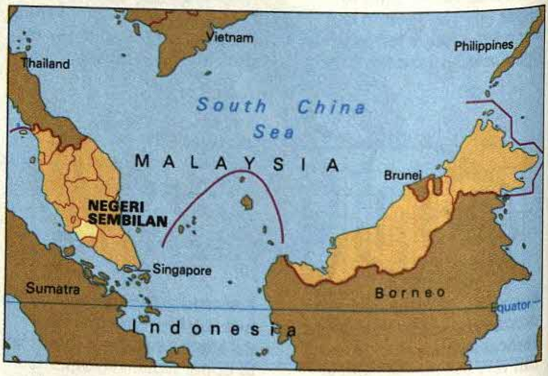
A traditional house of the Minangkabau people in Negeri Sembilan is built on stilts and has a concave roof ridge.

Facts in brief about Negeri Sembilan

Population: *1991 census*—691,150.
Area: 6,645 km².
Largest cities: Seremban, Kuala Pilah, Port Dickson, Tampin, Kuala Klawang, Bahau.
Chief products: *Agriculture*—forest products, palm oil, rubber. *Manufacturing*—ceramic tiles, electrical goods, processed food, textiles.

History. During the 1400's, many Minangkabau people migrated from Sumatra to Negeri Sembilan. The powerful sultan of Melaka granted the settlers his protection. With the fall of Melaka to the Portuguese at the beginning of the 1500's, the Minangkabau states came under the protection of the *sultans* (rulers) of Johor. But by the early 1700's, Johor was no longer able to protect the Minangkabau from the Bugis, traders from Celebes (Sulawesi) now in Indonesia, who had settled in Selangor. Many people believe that the Minangkabau then looked to the royal house of their Sumatran homeland for a prince who would unite the nine separate states into a federation. That prince was Raja Melewar who, in 1773, became the first ruler of Negeri Sembilan.

But the creation of that confederacy did not bring



Negeri Sembilan is a state that forms part of Peninsular Malaysia. Much of it is mountainous.

lasting unity. For the next 100 years, there was conflict between the states. In the mid-1800's, Sungai Ujong became the centre of a tin rush. Chinese miners and merchants fought for control of the tin trade.

In 1874, the British intervened to establish a *resident* (government representative) in Sungai Ujong. In the 1880's, the British appointed officials to other members of the confederacy. Negeri Sembilan became a confederacy once again under a single British resident in 1875. The following year, the state, together with Selangor, Perak, and Pahang, formed the Federated Malay States, with the federal capital in Kuala Lumpur.

During the late 1800's and early 1900's, the state became an important rubber-producing area. Many Indians arrived to work as rubber tappers. In 1948, Negeri Sembilan became part of the Federation of Malaya, which became independent of British rule in 1957.

See also **Malaysia.**

Negev is the triangular southern half of Israel. It extends from Beersheba south to the port of Elat on the Gulf of Aqaba (see **Israel** [terrain map]). The Negev is a semidesert tableland from about 300 to 600 metres above sea level. It includes both flatlands and limestone mountains. Much of the Negev is covered by a layer of fertile loam. The Israelis farm part of the Negev by irrigating the land with water brought from the Sea of Galilee. Phosphates and copper are mined in the Negev.

Negligence is the legal term for carelessness under the English legal system and systems based on it. The law uses negligence as a test to determine whether a person involved in an accident is responsible for any loss or injury that occurs in the accident.

The law considers negligence the failure to act the way a reasonable person would under the circumstances. However, the law does not say what specific conduct is negligent. This decision is made by a judge or a jury. The basic rule is that a person whose negligence harms another person must pay compensation, called *damages.* If the person harmed has also been negligent, damages cannot normally be recovered. The law calls such action *contributory negligence.* For example, if a careless motorist hits a pedestrian who is reading a newspaper while crossing the street, the pedestrian's carelessness may be contributory negligence.

English law generally does not regard negligence as a crime. But in cases where someone is killed through negligence, the negligent person may be charged with a crime called *manslaughter.* Most people convicted of this type of manslaughter are punished seriously, but less severely than someone convicted of murder.

Some experts say the negligence test is no longer a good one for the law. In car accidents, for example, compensation depends on the negligent person having enough money to pay the injured person. Because of this, car insurance is compulsory in many countries.

See also **Damages; Tort.**

Negotiable instrument refers to a type of legal exchange or document that is either a promise or an order to pay money. Negotiable instruments are used as evidence of indebtedness or as a substitute for money as they can be transferred from person to person. A person holding a negotiable instrument is usually in a good legal position to collect from the person who signed it. The signer is called a *maker* or *drawer.* The use of negotiable instruments is regulated by law. Negotiable instruments generally have the following characteristics: (1) they are in writing; (2) they are signed by a maker or drawer, who promises to pay money; (3) they contain an unconditional promise or order to pay; (4) payment is a definite sum of money and no more; (5) instruments are payable on demand or at a specific date; (6) they are payable to the bearer or to the order of a person.

Forms. Common forms of negotiable instruments include promissory notes, bills of exchange, and cheques. Promissory notes include bonds, certificates of deposit from banks, and bank notes. Bills of exchange include bank drafts, cashier's cheques and traveller's cheques.

Many instruments are not strictly negotiable but have some features of negotiable instruments. For example, instruments calling for the delivery of goods or property instead of money may possess many of the legal qualities of negotiability. Bills of lading and warehouse receipts are examples. A bill of lading is given for goods in transit. A warehouse receipt is given for goods in storage. Each of these instruments can be written so that the promise to pay is negotiable.

Endorsement. Negotiable instruments are usually transferred or handed over to another person by endorsement. Any writing on the back is, in its broadest sense, an endorsement. The word comes from the Latin *in dorso,* meaning *on the back.* The term applies technically to the signature or other writing which indicates or proves that the instrument has been transferred.

An endorsement may be written in different ways. If the holder of the instrument simply signs it, the endorsement is called *in blank. A special endorsement* or an *endorsement in full* names the person to whom payment is to be made. A *restrictive endorsement* forbids further transfer. In the United Kingdom, for example, a crossed cheque is a restrictive endorsement.

Every endorser of a negotiable instrument is usually liable for its face value, if the maker does not or cannot pay it. The endorser may add the words *sans recourse* (without recourse) if he or she wishes to avoid liability. Such an endorsement does not affect the value of the instrument or prevent further endorsement.

Related articles in *World Book* include:

Bill of exchange
Bill of lading
Bond
Cheque
Commercial paper
Money order
Note
Postal order
Promissory note

Negrillos. See **Pygmies.**

Negritos are peoples who live in small, isolated groups in Asia and northern Australia and who resemble Pygmies. They spread from the Andaman Islands of the Indian Ocean to the Malay Peninsula, the Philippines, Indonesia, New Guinea, and Australia. Like African Pygmies, Negritos have dark skin and tightly curled brown hair and are less than 1.5 metres tall. Negritos have traditionally lived by hunting and by gathering plants and fruits. Today, however, many Negritos are gradually becoming like the peoples of more complex societies.

Negroid race. See **Races, Human** (How races are classified; table).

Negros. See **Philippines** (The main islands).

Nehemiah, Book of, is a book of the Hebrew Bible, or Old Testament. It is named after an important figure in Judea in ancient Palestine. Nehemiah was appointed governor of Judea by the ruling Persians, serving in that office from 445 to 433 B.C. and for several more years after 432 B.C. His vigorous programmes of political and religious reforms, recorded in the Book of Nehemiah, renewed and restored the faltering Jewish community in Palestine in the 400's B.C. See also **Ezra, Book of; Bible** (The Old Testament).

Nehru is the name of a family that provided four generations of leaders for India. These were Motilal Nehru, and three prime ministers: Motilal's son, Jawaharlal Nehru; his granddaughter, Indira Gandhi; and his great-grandson, Rajiv Gandhi. See **Gandhi, Indira; Gandhi, Rajiv.** Motilal's daughter Vijayalakshmi Pandit was the first woman president of the United Nations General Assembly. See **Pandit, Vijayalakshmi.**

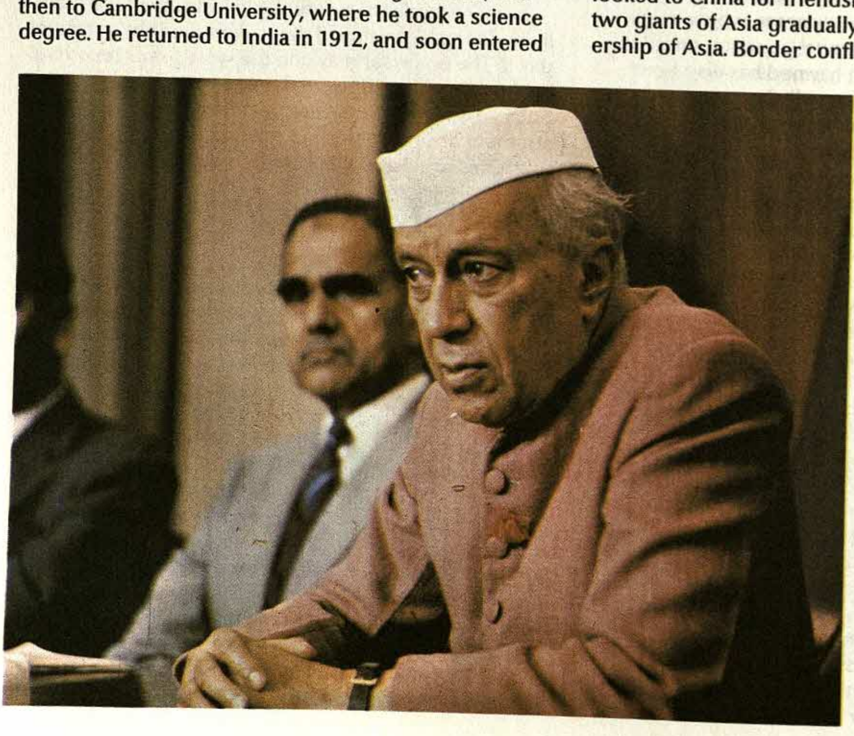
Motilal Nehru (1861-1931) belonged to a distinguished Brahmin family from Kashmir. After studying law at Muir College in Allahabad, he built up a prosperous legal practice and adopted a Western style of life. He played an active role in the Indian National Congress. It was only in 1920, however, that, partly under the influence of Mohandas Gandhi, he committed himself fully to the nationalist cause (see **Gandhi, Mohandas Karamchand**). He took part in campaigns of direct action and was jailed twice. He also led the nationalist opposition within the Legislative Assembly that the British had established. In 1928, he prepared what has become known as the Nehru Report. This was the first attempt to prepare a constitution for an independent India.

Jawaharlal Nehru (1889-1964) was Motilal Nehru's son and India's first prime minister. He had a long-lasting effect on the country's institutions and aspirations. He also played a major role in world affairs as one of the founders of the nonaligned movement.

Nehru was born in Allahabad. He was sent by his father to Harrow, one of England's leading schools, and then to Cambridge University, where he took a science degree. He returned to India in 1912, and soon entered the nationalist struggle against the British. In 1920, he took part in the noncooperation movement. This was a turning point in his life in two ways. It brought him into contact with Mohondas Gandhi (see **Gandhi, Mohandas**), to whom he remained close throughout his life, and it gave him direct experience of the levels of poverty that existed in the Indian countryside. From this time onward his whole life was dominated by the nationalist struggle. He was sent to prison on many occasions by the British. Nehru served as president of the Indian National Congress in 1929, 1936, 1937, and 1946, as well as after independence.

Nehru played a key role in negotiating independence and was the obvious choice as prime minister in 1947. He held office with no serious challenge until his death in 1964, and led the Congress Party to victory in three successive general elections. It was under Nehru's inspiration that India adopted a constitution which rejected religion in civic affairs and adopted parliamentary democracy. He was also convinced that India could only progress economically by adopting a form of planning that would make the best use of modern science and technology. The Planning Commission that he established oversaw a series of five-year plans during which steel and other heavy industries were set up under state control. Nehru was determined to turn India into a socialist society, but he insisted that it had to be achieved through the democratic process.

In the international sphere, Nehru worked with Egypt's leader Gamal Nasser and Yugoslavia's Josip Tito to establish the nonaligned movement. Nehru also established friendly relations with the Soviet Union. This move led to some hostility towards India from the United States. The hostility was made worse by what India saw as a U.S. bias towards Pakistan. Initially, Nehru looked to China for friendship and cooperation, but the two giants of Asia gradually became rivals for the leadership of Asia. Border conflicts developed into full-scale



Jawaharlal Nehru (seen on the right in this photograph) was the first prime minister of India. He served from 1947 until his death in 1964 and played a major role in world affairs.

war in 1962. The war ended as a humiliating defeat for India, which cast a shadow over Nehru's last years. He died after a stroke in May 1964.

Not all of Nehru's work has survived, especially in the economic field, where the large state-owned industries have been seen as a drag on growth. But even his fiercest critics would recognize that modern India owes much to his vision and leadership.

See also **India, History of.**

Neilson, John Shaw (1872-1942), is rated by critics as Australia's finest lyric poet. This achievement is especially remarkable in view of Neilson's unsophisticated background and limited experience. Neilson had poor eyesight and had to work long, hard hours. Because of these problems, he often found it difficult to write.

Neilson said that he had to keep to simple rhymes and metres that he could remember until he had the chance to dictate them or write them down. He wrote much of his poetry in simple rhymed couplets or four-line verses. He rarely wrote long poems. As a result, his poetry seems simple. But his delicate handling of language and his unusual perception of colour produce effective visual patterns and a high lyrical quality.

Neilson had pronounced ideas on colour. To him, green meant youth; violet, death; red, violence; and white, innocence or childhood. This use of colour produces startling and, at times, amusing descriptions.

The poetry Neilson wrote is not greatly concerned with Australian landscape, but rather with the living things moving through it. He was particularly fascinated by birds and trees. His most popular and representative poem is "The Orange Tree."

Neilson did not try to expound any particular philosophy. He tried only to express his own ideas of beauty. His poetry was inspired by the bush, and it communicates his own feeling of the beauty of the bush, rather than providing a pictorial description.

Neilson was born in Penola, South Australia. He received only a sketchy education and spent most of his life in the bush working at farming or at manual jobs.

Nekton. See **Ocean** (The nekton; pictures).

Nelson (pop. 47,391) is a city on the northern coast of the South Island of New Zealand. It stands at the head of Tasman Bay and is the chief port and only city in Nelson province. The city is the market centre for an important tobacco, hop, and fruit-growing area. It is noted for its sunny climate and its fine beaches.

Nelson has the Cawthron Institute, one of New Zealand's leading agricultural research establishments, and Nelson College, one of the country's outstanding schools. Queen Victoria made Nelson a city in 1858.

Nelson, Horatio (1758-1805), was Great Britain's greatest admiral and naval hero. He defeated the combined French and Spanish fleets at Trafalgar in the greatest naval victory in British history. His victory broke France's naval power, and established Britain's rule of the seas for the rest of the 1800's.

Early life. Nelson was born at Burnham-Thorpe in Norfolk, on Sept. 29, 1758. His father was rector of the local church, and his mother was a member of the famous Walpole family. Nelson was a small, frail child. But he fell in love with the sea early in life, and made up his mind to be a sailor. He spent much time piloting small boats on the river near his home. When he was 12 years old, his uncle, Captain Maurice Suckling, planned a voyage to the Falkland Islands. Nelson begged his family for permission to go along, and was finally allowed to do so. He owed much of his early training to Captain Suckling, who transferred him from time to time to ships engaged in different types of service. Suckling also encouraged him to study navigation and to practise sailing.

Horatio Nelson

Joins the Navy. At the age of 15, Nelson went aboard the *Carcass* as a coxswain. He served on that vessel in an expedition to the Arctic seas. On his return, he was sent to the East Indies on the *Seahorse.* On the East Indies voyage he caught a fever that seriously damaged his health. But he became a lieutenant in the Royal Navy at 18.

In 1779, when not yet 21, he was given command of the frigate *Hinchinbrook.* He was known as a capable officer. His professional ability and his talent for getting along with his men helped him to rise rapidly in the service. A cruise to Central America brought on a second tropical illness and Nelson was sent home in feeble health.

He was given duty on the North Sea as soon as he recovered from the fever. He was then assigned to service in Canadian waters and developed a great fondness for Canada, where the climate strengthened his health. Nelson was given command of the frigate *Boreas,* which was stationed in the West Indies in 1784. He spent three years there.

Nelson married the widow of Josiah Nisbet, an English doctor, in the West Indies in 1787. Prince William, who later became King William IV of England, gave the bride away at the wedding. Nelson was recalled from active service soon afterward. He remained on the retired list until soon after the outbreak of war with France in 1793.

Wounded at Calvi. In 1793, he was placed in command of the *Agamemnon* and sailed to join the Mediterranean fleet. This voyage began seven years of almost continual warfare at sea. Nelson was one of the British commanders who blockaded Toulon and captured Corsica. He was wounded at Calvi, on the Corsican coast, and lost the sight of his right eye.

Nelson next distinguished himself at the Battle of Cape St. Vincent in 1797. He served under Admiral Sir John Jervis, who defeated the combined French and Spanish fleets. Nelson was made a Knight of the Bath for his part in this victory. He had become a rear admiral a week before the battle. A few months later, Nelson led a small landing party in an attack on the strongly fortified port of Santa Cruz de Tenerife in the Canary Islands. The attack was a bold gamble, but unlike others, it failed. The British were driven off with heavy losses and Nelson's right arm was badly mangled up to the elbow. The arm had to be cut off in a crude amputation in a pitching boat, and Nelson was invalided home to England in great pain. But he soon returned to duty.

Battle of the Nile. Napoleon, victorious in Europe, began to gather a French fleet for an expedition to conquer Egypt. Nelson was sent to watch the French ships at Toulon. A storm came up, and under its cover the French fleet escaped. Nelson followed it in a long and tiresome pursuit. He finally cornered the French fleet in Abu Qir Bay. There he attacked and almost destroyed it on Aug. 1, 1798. This engagement is known to history as the Battle of the Nile. It cut off Napoleon's army in Egypt and ruined his Egyptian campaign. Napoleon was forced to desert his army in Egypt, and had to sneak across the Mediterranean in a tiny ship. The victory over Napoleon in the Battle of the Nile made Nelson famous. He was made Baron of the Nile and given a large sum of money by the state.

Nelson was wounded again in this battle, and he went to Naples to recover. Lady Emma Hamilton, wife of Sir William Hamilton, the British Ambassador to Naples, fell in love with the battered, one-eyed, one-armed naval hero and became his mistress. Her influence over Nelson became so great that he disobeyed his orders to leave Naples and join a squadron in the Mediterranean. It was Nelson's good fortune that no British defeat resulted from his refusal to leave Naples. Nelson was condemned for his conduct, however, when he returned to England.

Battle of Copenhagen. Nelson became a vice-admiral in 1801, and sailed for Copenhagen in the squadron of Admiral Parker. Great Britain had claimed the right to search neutral ships for contraband of war. Denmark refused to allow its ships to be searched. A council of war chose Nelson to make the attack on the Danish fleet. Admiral Parker later became doubtful of the outcome. He signalled Nelson to retire. Nelson clapped his telescope to his blind eye and studied the signal. "I really do not see the signal," he said to an aide. He ignored the order and turned what might have been a defeat into a great victory. After the battle, Nelson was given the title of viscount.

Victory at Trafalgar. Nelson was made commander in chief of the fleet in May 1803. Sailing on the flagship *Victory,* he once more went in search of the French. He found the fleet at Toulon, but it slipped away from him. Nelson chased the French to the West Indies and back. It was more than two years before he was able to bring the French fleet to battle off Cape Trafalgar on the coast of Spain, on Oct. 21, 1805 (see **Trafalgar**). Nelson hoisted his famous signal, "England expects that every man will do his duty." With only 27 vessels, he attacked the combined French and Spanish fleets. One of the great naval battles of all time followed. Napoleon's fleet, which had a total of 33 warships, was destroyed. Nelson was wounded at the height of the battle. He was carried below with a bullet embedded in his spine. Nelson died during the battle, but he lived long enough to know that the British fleet had defeated the French and Spanish fleets. Nelson's last words were, "Thank God I have done my duty."

One of Nelson's great characteristics as a commander was his willingness to give full credit to his officers and men. After the Battle of Copenhagen, he refused an honour given him by the City of London because he alone was to be honoured. Nelson replied, "Never till the City of London thinks justly of the merits of my brave companions of the second of April can I, their commander, receive any attention from the City of London." The poet Robert Southey wrote of Nelson, "England has had many heroes. But never one who so entirely possessed the love of his fellow countrymen. All men knew that his heart was as humane as it was fearless . . . that with per-

Detail of *Nelson Falling* (1825), an oil painting on canvas by Denis Deighton; National Maritime Museum, Greenwich, England

Horatio Nelson led the British to victory over the French and Spanish fleets at Trafalgar in 1805. Nelson, Britain's greatest naval hero, was fatally wounded in this battle, *above right.*

fect and entire devotion he served his country with all his heart, and with all his soul, and with all his strength."

Nelson is perhaps best remembered today by the members of the British Navy. He was a fighter. "I am of the opinion that the boldest measures are the safest," he once said. Nelson's frail body housed a great spirit. He was able to inspire men with his own courage and confidence. Nelson is a symbol of the United Kingdom's navy.

Nelspruit (pop. 61,921) is an important town in the province of the Eastern Transvaal, South Africa. It lies in the Transvaal *lowveld* (region of low-lying land) at the centre of the second-largest citrus farming area in southern Africa. For the location of Nelspruit, see **South Africa** (political map).

The Nelspruit area was once a sheep farm run by a family named Nel. Their farm developed into a town after the railway from Pretoria reached it in 1891. The government of the South African Republic (Transvaal) established headquarters at Nelspruit for a few weeks during the Second Anglo-Boer War of 1899 to 1902.

Neman River is a waterway in eastern Europe. The Neman—also called Memel, Nemunas, or Niemen—rises southwest of the city of Minsk in Belarus. It flows generally westward through Belarus and Lithuania, and empties into the Baltic Sea.

The Neman flows 937 kilometres through a landscape of lakes and forests. Its chief tributaries are the Viliya, Shchara, Sheshupe, and Merkys rivers. The Neman is frozen from late November until March. During the rest of the year, it is used for floating timber. Barges can sail up the Neman for about 645 kilometres from its source. A dam on the river near the city of Kaunas, Lithuania, has a hydroelectric power plant.

Nematoda, also called *roundworms,* is a group of slender, round worms. Individuals in the group are called *nematodes.* Their bodies are usually pointed at the ends. Some are so small they can be seen only through a microscope, and others grow to over 90 centimetres long. Males are usually smaller than females. More than 15,000 different kinds of nematodes have been described.

Nematodes can be found in all habitats. Some live in soil and water. Many, such as the eelworm, live as parasites in plants. Others, including hookworms, lungworms, pinworms, trichinae, and filariae, live as parasites in human beings, and such animals as dogs, sheep, and horses.

Scientific classification. The nematode belongs to the phylum Nematoda.

Related articles in ***World Book*** include:

Eelworm
Hookworm
Pinworm
Roundworm
Trichina
Vinegar eel

Nematomorpha. See **Horsehair worm.**

Nemean Games were one of the four ancient Greek national festivals. The others were the Isthmian Games, the Olympic Games, and the Pythian Games.

The Nemean Games occurred every other year. They were held at the shrine of Zeus in Nemea, a valley in eastern Peloponnesus. They included athletic and musical contests. The first recorded Nemean Games took place in 573 B.C.

Nemertina. See **Ribbon worm.**

Nemesis, a minor goddess in Greek mythology, was a personification of the spirit of vengeance. Nemesis made sure that no wrongdoer escaped punishment. As the one who avenged evil deeds, she was an instrument of justice in all matters. Today, the word *nemesis* means retribution, or an instrument of retribution.

Nene, also known as *Hawaiian goose,* is a rare bird of Hawaii. It also is the official bird of Hawaii. Nenes measure 56 to 66 centimetres long and are brown with long, buff-coloured neck feathers. They live in open country and feed chiefly on grass. The female lays three to six creamy-white eggs. In 1950, only about 50 nenes existed. Since then, the number of nenes has greatly increased due to breeding and protection programmes.

Scientific classification. The nene is in the family Anatidae. It is *Nesochen sandvicensis.*

See also **Bird** (picture: Birds of Oceanic Islands).

Neoclassicism. See **Classicism; English literature** (The Augustan Age); **Literature** (The Age of Reason); **Painting** (The 1800's); **Sculpture** (Sculpture from 1600-1900); **Spanish literature** (Neoclassicism); **Drama** (French neoclassical drama).

Neocolonialism. See **Colonialism.**

Neo-Darwinism. See **Darwin, Charles R.** (The influence of Darwin's ideas).

Neodymium is a chemical element with the symbol Nd. It is a metal belonging to the rare earth group. Its atomic number is 60, and it has an atomic weight of 144.24. C. F. Auer von Welsbach of Austria discovered the element in 1885. He separated the so-called element didymium into neodymium and praseodymium. Neodymium melts at 1021 °C, and boils at 3074 °C. It has a density of 7.003 grams per cubic centimetre at 25 °C. The metal can be prepared by electrolysis of its halide salts, or by the reduction of these salts by alkaline earth metals in the presence of heat. The ceramic industry uses salts of neodymium to colour glass and in glazes. The metal is present in *misch metal,* an alloy with many uses, and in the important Nd-YAG laser.

See also **Element, Chemical** (tables); **Rare earth.**

Neoimpressionism. See **Seurat, Georges.**

Neolithic Period. See **Prehistoric people** (Changes in life style); **Stone Age.**

Neo-Malthusianism. See **Malthus, Thomas Robert.**

Neon is a chemical element that makes up about 1 part per 65,000 in the earth's atmosphere. The British chemists Sir William Ramsay and Morris Travers discovered it in the atmosphere while they were studying liquid air in 1898. Ramsay had predicted the existence of this gas one year earlier. Ramsay and Travers named the gas *neon,* after the Greek word meaning *new.*

Neon is used chiefly for filling lamps and luminous sign tubes. Its usual colour in lamps is bright reddish-orange. The addition of a few drops of mercury makes the light a brilliant blue. Many aeroplane beacons use neon light because it can penetrate fog.

Commercially, neon is obtained as a by-product of liquid air manufacture. Neon liquefies under normal pressure at −246.048 °C, and it freezes at −248.67 °C. When air is liquefied at about −200 °C, neon is left behind as a gas. Neon is expensive, but very little is needed for lamps. Signs use 1 litre per 65 to 100 metres of tubing. Liquid neon is often used as a low-temperature *refrigerant* (cooling agent).

Neon signs brighten entertainment and shopping areas. This hotel in Las Vegas, U.S.A., has glowing signs to attract visitors. Shops often use neon signs to advertise products.

Neon is a colourless, odourless gas. It does not react readily with other substances, though it may form a compound with fluorine. Neon is classed as a *noble gas.* Its symbol is Ne. It has the atomic number 10, and an atomic weight of 20.179.

See also **Electric light** (Neon lamps); **Noble gas.**

Neon tetra. See **Fish** (picture: Fish of tropical fresh waters).

Neoplasm. See **Tumour.**

Neoplatonism was a dominant school of philosophy from the A.D. 200's to the 500's. Neoplatonism, which means *New Platonism,* developed from the philosophy of Plato. It also absorbed elements of Pythagorean, Aristotelian, and Stoic thought. Plotinus founded Neoplatonism. Other leading Neoplatonists included Plotinus' followers Porphyry and Proclus.

The Neoplatonists developed their philosophy from Plato's theory of *forms.* According to this theory, all things that can be perceived are only imperfect copies of forms, which are their perfect essence. Knowledge comes from grasping with the mind the essential form of a thing, rather than from perceiving with the senses its many incidental qualities. Plotinus went beyond this theory to divide Plato's realm of forms into various levels of reality. Each level depends for its reality on those above it.

Transcending all reality is *The One,* which is in itself unknowable. One cannot even say that The One *is,* because The One is beyond being. But The One expands or "overflows" into the levels beneath it, as light shines through darkness, becoming dimmer as it goes. The highest level of reality is that of *Intellect,* in which forms exist as ideas beyond time and space. The next level, dimmer and less real, is that of *Soul.* Next is the level of *Nature,* the dark realm of material bodies. Beneath these levels is *Matter,* which Plotinus describes as "not-being" and as the principle of evil. We inhabit the lower levels but yearn to turn upward and return to the higher ones. Our souls can leave our bodies and "travel" to the realm of Intellect, where forms reside as ideas in the divine mind.

The Neoplatonists believed that the purpose of philosophy is to escape from the attachment we feel to our bodies and physical environment. In this way, we achieve immortality by finding our true place in the world of forms.

Neoplatonism was an important philosophical movement. Plotinus influenced Saint Augustine in developing his principles of Christian theology. Proclus' views helped shape Christian *negative theology,* which points out the limits of human ability to comprehend a supreme being. Neoplatonist thought influenced Near Eastern philosophy as early as the A.D. 400's. The Neoplatonic emphasis on spiritual, as opposed to physical, beauty was important to the idea of *platonic love* during the Renaissance.

See also **Plato; Plotinus; Philosophy** (Plato; Neoplatonism).

Neoprene. See **Rubber** (Special-purpose rubbers).

Neoptolemus was a Greek warrior during the Trojan War. He was also called Pyrrhus. His father was the Greek hero Achilles. After Achilles died in the war, Neoptolemus helped the Greeks defeat the Trojans. As the Greeks captured Troy, Neoptolemus mercilessly killed Priam, the aged Trojan king.

Nepal is a country in south-central Asia. The highest mountain range in the world—the Himalaya—and a region of hills and valleys cover about 80 per cent of Nepal. The Tarai (or Terai)—a flat, fertile river plain along Nepal's border with India—covers the rest of the country.

Kathmandu is the capital of Nepal and its largest city. Mount Everest, the highest mountain in the world, rises 8,848 metres above sea level in the Himalaya on Nepal's border with Tibet, a region that is part of China.

Facts in brief about Nepal

Capital: Kathmandu.

Official language: Nepali.

Area: 140,797 km^2. *Greatest distances*—east-west, 805 km; north-south, 241 km.

Elevation: *Highest*—Mount Everest, 8,848 m above sea level. *Lowest*—46 m above sea level.

Population: *Estimated 1996 population*—20,813,000; density, 148 people per km^2; distribution, 86 per cent rural, 14 per cent urban. *1981 census*—15,022,839. *Estimated 2001 population*—23,340,000.

Chief products: Cattle, maize, rice, oilseeds, wheat.

National anthem: "Rashtriya Dhun" ("National Anthem").

Flag: The flag has two crimson triangles trimmed in blue, one above the other. The top triangle features the moon and the lower one the sun, symbols of the long life of Nepal. It is the only nonrectangular country flag. See **Flag** (picture: Flags of Asia and the Pacific).

Money: *Currency unit*—Nepalese rupee. One rupee = 100 paisa.

Nepal has a population of about 20 million and an area of 140,797 square kilometres. About 45 per cent of Nepal's people live in the Tarai. The rest of the people live in the hills and valleys region or in the mountains. Patches of farmland lie among the mountains of Nepal. These cultivated areas account for only about 10 per cent of the country's mountainous area, but almost all of the mountain people live there. Nepal is poor and undeveloped and has a high rate of disease.

Government. Nepal is a constitutional monarchy. A prime minister serves as head of the government. The king serves as head of state and commander in chief of the armed forces. Nepal's parliament consists of a 60-member National Council and a 205-member House of Representatives. The people elect the representatives to five-year terms. Thirty-five members of the National Council are elected by the house, 15 members are elected by an electoral college, and 10 are appointed by the king. Members of the National Council serve six-year terms. The king appoints the leader of the majority party in the house as prime minister. The prime minister heads a council of ministers, who are appointed by the king on the advice of the prime minister. The council helps carry out the functions of government.

Nepal is divided into 75 districts for purposes of local government. Each district is divided into cities and villages. The people elect a committee and a committee head to administer each district, city, and village.

The Supreme Court is Nepal's highest court. It consists of a chief justice and 14 judges. The chief justice is appointed by the king, upon recommendation of a constitutional council. The other judges are also appointed by the king, upon recommendation of a judicial council.

People. Most Nepalese are closely related to the peoples of northern India. Other Nepalese are of Tibetan descent. Still others are of mixed Indian-Tibetan descent. Most people live in small villages in two-storey houses made of stone or mud brick.

About 90 per cent of Nepal's people work on the land. Most farms produce barely enough to support one family. Nepalese farmers trade any surplus crops they grow for such important items as paraffin and salt. Other Nepalese make their living as craftworkers, such as blacksmiths, goldsmiths, shoemakers, and tailors. Still others work as merchants, for the government, or in tourism.

The Sherpas and the Gurkhas, two Nepalese groups, are known for their special skills. The Sherpas, a Himalayan people, have won fame as guides and porters for mountain-climbing expeditions. Sherpa men and women carry heavy loads up to high altitudes. Gurkhas are Nepalese soldiers in the British or Indian army.

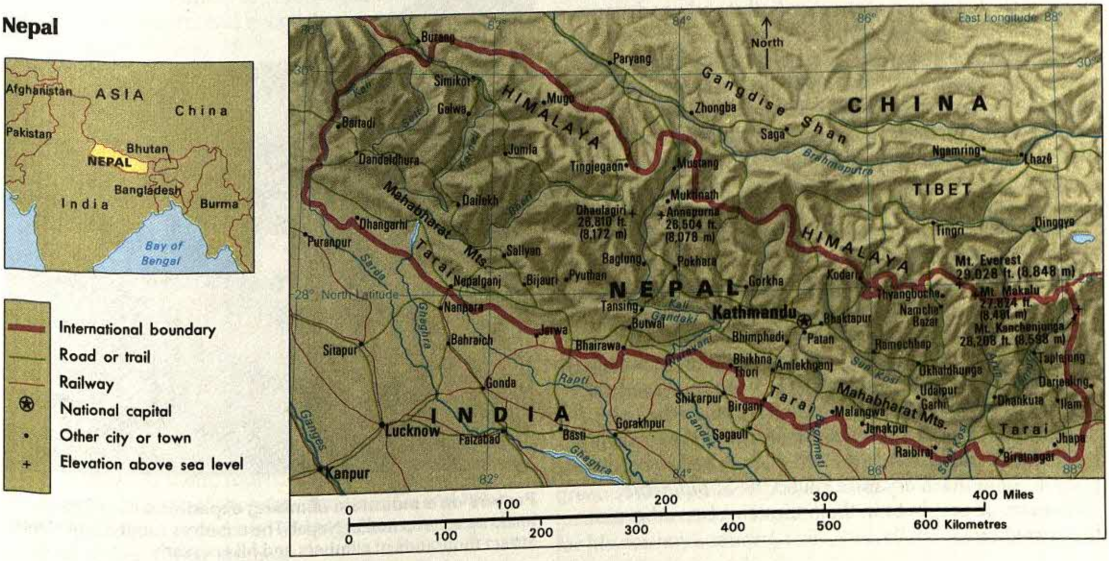
Hinduism is the official religion of Nepal. However, the Nepalese have combined the beliefs and practices of Hinduism with those of Buddhism. Buddha, the founder of Buddhism, was born in Nepal about 563 B.C. The Nepalese people celebrate the festivals of both Buddhism and Hinduism, and Buddhist shrines and Hindu temples are considered equally sacred. Many of the people of Nepal also worship local gods and spirits and consult *shamans* (witch doctors) in times of illness.

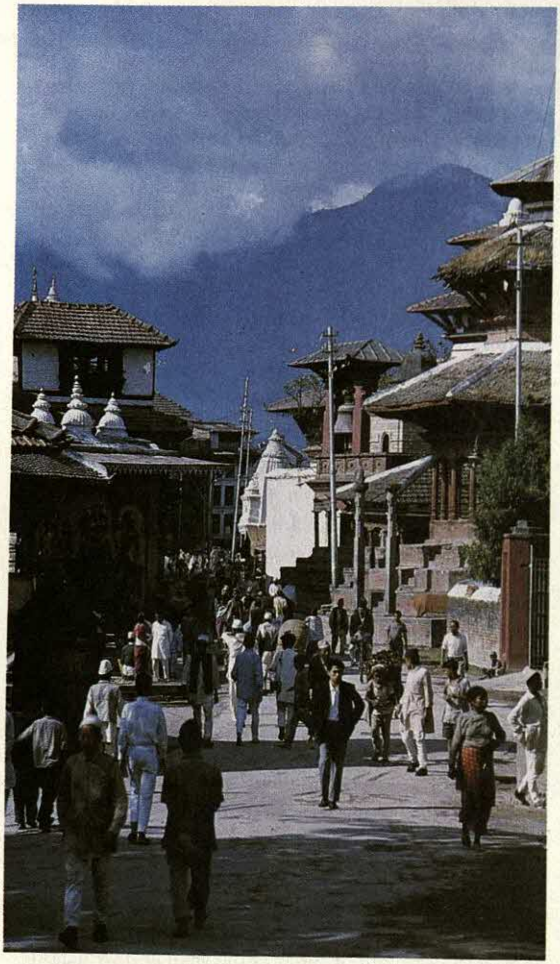
Nepal has few doctors, and such diseases as cholera, leprosy, and tuberculosis occur frequently. Since the 1950's, the government has greatly reduced malaria. This has enabled people from the mountains to settle in the Tarai, where malaria used to be widespread.

Some Hindus in Nepal practise *polygyny,* a form of marriage in which a husband has more than one wife. *Polyandry,* the practice of a wife having more than one husband, occurs among some of the Tibetan groups in northern Nepal. In most such cases, the woman marries two or more brothers. The children who are born of such marriages regard the oldest husband as their father and his brothers as uncles.

Illiteracy ranks as one of Nepal's most serious problems. During the 1950's, the government began a programme to build schools and train teachers throughout Nepal. At that time, perhaps as few as 5 per cent of the people 15 years old or older could read and write. The programme has helped increase the percentage to about 20. Tribhuwan University is Nepal's only univer-

Nepal





Kathmandu, Nepal's capital and largest city, lies at the foot of the Himalaya. Multistorey temples called *pagodas,* such as the ones shown above, line many of Kathmandu's streets.

sity. It includes a main campus in Kathmandu and many other campuses in the country.

About half of the people speak Nepali—the country's official language—as their native tongue. Most of the rest of the people use Nepali as a second language. Nepali is related to the languages of northern India. More than 50 other languages and dialects are spoken.

Land and climate. Nepal has three principal regions: (1) the Himalaya, (2) the hills and valleys, and (3) the Tarai. Differences in altitude give each region a different climate. Each region also has its own kinds of wildlife.

The Himalaya, in the north, covers much of Nepal. The mountains have long, harsh winters and short, cool summers. Steep river valleys cut through the glaciers and snow of the Himalaya. Forests cover the mountains up to the altitude of about 3,660 metres above sea level. Only grasses, lichens, and moss can grow in the cold, dry air above this altitude. Mountaineers in the Himalaya herd sheep and also long-haired oxen called *yaks.* Some people claim that a creature called the *abominable snowman,* or *yeti,* lives in the mountains (see **Abominable snowman**).

The hills and valleys lie south of the Himalaya. The valleys have a cool climate, and rain falls heavily in summer. Winters are chilly but dry. Farmers on the hillsides and in the valleys grow many crops. The crops include maize, rice, millet, and wheat. The farmers tend herds of cattle, sheep, and goats. A wide variety of trees and bamboo grasses grows in thick forests in this region.

The Tarai lies in southern Nepal. It has fertile farmland. Farmers in the Tarai grow maize, jute, millet, mustard, rice, sugar cane, tobacco, and other crops. Livestock reared there includes cattle and water buffalo. The Tarai has a tropical climate. Its jungles and swamps support plentiful wild game, including crocodiles, elephants, deer, leopards, rhinoceroses, and tigers.

Economy of Nepal depends almost entirely on farming. Nepalese farmers attend small fairs and markets to trade their surplus crops for other items. Nepal has few railways or paved roads. The lack of good transportation facilities makes large-scale trade difficult.

Roads link Nepal with India, and Nepal trades chiefly with that country. Nepal exports such produce as herbs, jute, rice, spices, and wheat. Principal imports include petrol, paraffin, machinery, metals and metal products, and textiles.

Since the 1950's, large amounts of foreign aid have helped develop Nepal's economy. For example, China, Great Britain, India, Switzerland, and the United States have contributed money to Nepal. The foreign aid funds have helped construct roads, maintain health centres, and start small industries throughout the country. The Nepalese government spends about 255 million U.S. dollars annually on development projects. Approximately 50 per cent of this money comes from foreign aid and loans.

Gurkha soldiers employed in the British and Indian armies make a significant contribution to Nepal's economy. The salaries and pensions paid to these Nepalese soldiers total more than 32 million U.S. dollars yearly.

Porters on a mountain-climbing expedition carry heavy loads up a steep trail in Nepal. The country's rugged mountains attract thousands of climbers and hikers yearly.

Money spent by visitors from other countries has helped improve economic conditions in Nepal. More than 150,000 tourists visit Nepal annually.

Nepal has deposits of such minerals as coal, copper, gold, iron, and mica. However, the country has few mines. Nepal's greatest natural resources are its forests and rivers. The swift mountain currents produce hydroelectric power.

History. Until the late 1700's, Nepal consisted of a number of small, independent kingdoms. About A.D. 400, the Kathmandu Valley, where the Nepalese capital is now located, came to be called Nepal. Through the centuries, bands of conquerors, nomads, and refugees moved into Nepal. They came from Central Asia, India, and Tibet and were the ancestors of the Nepalese.

In the mid-1700's, Prithwi Narayan Shah, a king from a small Nepalese kingdom called Gorkha, began a military campaign to unify the country. By the time of his death in 1775, he had conquered most of what is now Nepal. He took the title of king of Nepal, and his descendants have served as monarchs ever since.

In the early 1800's, Nepal fought a war against Great Britain. Nepal had attempted to expand its boundaries into northern India. A British trading company called the East India Company controlled much of India at that time, and British soldiers guarded India's borders. Great Britain declared war on Nepal in 1814 after Nepalese troops attacked a British outpost.

The British expected an easy victory, but the Nepalese were accustomed to fighting in the mountains. The British Army suffered heavy losses but finally defeated the Nepalese in 1816. After the war, Britain and Nepal became allies. The Gurkha soldiers of the Nepalese forces impressed the British, and Britain has recruited Gurkhas for its armies since that time.

In 1846, a political leader named Jung Bahadur seized control of Nepal's government. He took the honorary title of *Rana* and declared that a member of his family would serve as prime minister from then on.

Until 1951, members of the Rana family held complete control of the government. During this period, the king had no power. The Ranas dominated the army, imprisoned their opponents, and even killed rivals whom they considered dangerous.

During the 1930's and 1940's, opposition to Rana rule grew in Nepal. A revolution began in Nepal in 1950. The revolution overthrew the government and restored the monarchy to power under King Tribhuwan Shah in 1951.

During the early 1950's, the government made various attempts to create a democracy in Nepal. King Tribhuwan died in 1955. He was succeeded by his son, Mahendra. Mahendra criticized the rivalry among political parties in democratic systems. In 1960, he declared that Nepal needed a political system that would suit its traditions. He dissolved the elected government that existed and took over power. Political parties were banned. In 1962, he put into effect a constitution that established the panchayat system, in which most power is held by the monarch.

Under Mahendra's rule, the government stressed economic development, tourism, road construction, and hydroelectric power. Mahendra died in 1972, and his son, Birendra, succeeded him as king. Birendra has continued his father's programmes.

In 1979, many Nepalese staged violent demonstrations, in part to demand a more democratic government. In response to the demands, Birendra allowed a national vote on the government system. By a narrow margin, the voters chose to continue Nepal's system.

In 1990, violent demonstrations calling for more democracy broke out again. The king lifted the ban on political parties, and an interim government was formed. In November 1990, a constitution was approved that made Nepal a constitutional monarchy. In May 1991, democratic multiparty parliamentary elections were held. The Nepali Congress Party won a majority of the seats in the House of Representatives. The Communist Party of Nepal finished second.

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Nephrite. See **Jade.**

Nephritis, formerly called Bright's disease, is a general term for several inflammatory diseases of the kidneys. *Glomerulonephritis* is the disease that is most often called nephritis. It involves an inflammation of the *glomeruli* (filtering units) of the kidneys. The inflammation often reduces the amount of urine produced by the kidneys, causing waste products normally eliminated in the urine to accumulate in the body. Severe or persistent glomerulonephritis can cause serious, permanent damage to the kidneys.

Most cases of glomerulonephritis follow an infection of the throat or skin caused by certain types of the bacteria called *streptococci.* In some people, such infections apparently cause the body to become allergic to the tissues of the glomeruli. The glomeruli may suffer serious damage as a result. If this damage occurs rapidly, the condition is called *acute glomerulonephritis.* If the damage continues over a period of years, the condition is called *chronic glomerulonephritis.*

Acute glomerulonephritis occurs mostly in children. Symptoms include facial swelling, fever, headache, high blood pressure, vomiting, and blood and proteins in the urine. There is no specific treatment. Nearly all patients recover from their first attack.

Chronic glomerulonephritis develops mostly in adults. In most cases, the specific cause is unknown. Many cases involve only mild symptoms so that a person may not even know that he or she has the disease. For some patients, treatment with medications can stop or even reverse the damage. But for many others, chronic glomerulonephritis causes progressive, incurable kidney damage. Advanced stages may lead to kidney failure and a potentially fatal condition called *uraemia* (see **Uraemia**). To prevent advanced uraemia, doctors may connect the patient to a *dialysis machine,* which removes wastes from the blood. Treatment may also be done by *ambulatory dialysis,* in which the patient manually drains and replaces abdominal fluids. In certain severe cases of chronic glomerulonephritis, doctors may perform a kidney transplant.

See also **Kidney; Tissue transplant; Bright, Richard.**

Nepia, George (1905-1986), one of New Zealand's greatest Rugby Union players, was the first Maori to gain an international reputation in this sport. He played for his country's touring team, the *All Blacks,* in 1924, 1925, 1929, and 1930. He represented New Zealand in 46 international rugby matches.

Nepotism is the practice of giving important political or business positions to members of one's family. The word *nepotism* comes from the Latin word for *nephew.*

Neptune was the god of the sea in Roman mythology. He had power over the sea and seafaring. For example, he could cause—or prevent—storms at sea. Neptune resembled the Greek god Poseidon. Like Poseidon, he was also the god of earthquakes and horses.

The ancient Romans were a seafaring people and imported much of their food and other necessities by ship. As ruler of the sea, Neptune thus had an important role in their daily life. Sea travel was dangerous in ancient times, and Roman sailors prayed to Neptune for safe voyages. After their return, sailors often showed their gratitude by dedicating a valuable object to Neptune.

Neptune was the son of Saturn and Ops (called Cronus and Rhea by the Greeks). He married the sea nymph Amphitrite, and they had a son, Triton, who was half man and half fish. Triton played an important role in many ancient legends about the sea.

Neptune appears in a famous episode at the beginning of the *Aeneid,* an epic by the Roman poet Virgil. In this epic, Neptune calms a storm that had threatened to destroy the fleet of the Trojan hero Aeneas. Many ancient and modern seascapes feature Neptune, Amphitrite, and Triton. Artists portray Neptune as a man carrying a *trident* (three-pronged spear). Some show him riding in a chariot pulled by sea horses and accompanied by dolphins. Many fountains, notably the Trevi Fountain in Rome, include a statue of Neptune. One of the planets is named after him.

See also **Poseidon; Triton.**

Neptune is one of the two planets that cannot be seen without a telescope. Neptune is about 30 times as far from the sun as is Earth. Pluto is the only planet farther from the sun than Neptune. But every 248 years Pluto moves inside Neptune's orbit for about a 20-year period, during which it is closer to the sun than Neptune. Pluto crossed Neptune's orbit on Jan. 23, 1979, and will remain within it until March 15, 1999.

Neptune's diameter is about 49,100 kilometres, or almost 4 times that of Earth. The planet is about 17 times as *massive* (heavy) as Earth, but is not so *dense* as Earth (see **Mass; Density**). It has eight *satellites* (moons). Astronomers have also detected several rings around Neptune.

Neptune travels around the sun in an *elliptical* (oval-shaped) orbit. Its mean distance from the sun is about 4,504,300,000 kilometres. Neptune goes around the sun once about every 165 earth-years, compared to once a year for Earth. As Neptune orbits the sun, it spins on its *axis,* an imaginary line through its centre. Neptune's axis is not *perpendicular* (at an angle of 90°) to the planet's path around the sun. The axis tilts about 30° from the perpendicular position (see **Planet** [illustration: The axes of the planets]). Neptune spins around once in about 16 hours and 7 minutes.

Surface and atmosphere. Scientists believe that Neptune is made up chiefly of hydrogen, helium, water, and *silicates.* Silicates are the minerals that make up most of Earth's rocky crust, though Neptune does not have a solid surface like Earth. Thick clouds cover Neptune's surface. The interior of the planet begins with a region of heavily compressed gases. Deep in the interior, these gases blend into a liquid layer that surrounds the planet's central core of rock and ice. The tilt of Neptune's axis causes the sun to heat the planet's northern and southern halves alternately, resulting in seasons and temperature changes.

Neptune is surrounded by thick layers of clouds in rapid motion. Winds blow these clouds at speeds up to 1,100 kilometres per hour. The clouds farthest from Neptune's surface consist mainly of frozen methane. Scientists believe that Neptune's darker clouds, which lie below the clouds of methane, are composed of hydrogen sulphide.

A dark region about the size of Earth appears in photographs of Neptune. This dark area, called the Great Dark Spot, consists of violently swirling masses of gas that resemble a hurricane. The high winds and the shape of the Great Dark Spot are similar to those of the Great Red Spot on Jupiter.

Satellites and rings. Neptune has eight known satellites. Only two of them—Triton and Nereid—can be seen by telescopes on the earth. The other six satellites and several rings around the planet were discovered by the U.S. *Voyager 2* spacecraft in 1989.

Triton, Neptune's largest satellite, is about 2,705 kilometres in diameter and about 355,000 kilometres from Neptune. It is the only major satellite in the solar system that orbits in a direction opposite to that of its planet. Triton has a circular orbit and travels once around Neptune every six days. Triton may once have been a large comet that travelled around the sun. At some point, Neptune's gravity probably captured the comet, and it became a satellite of Neptune. Scientists have discovered evidence that volcanoes on Triton once spewed a slushy mixture of water and ammonia. This mixture is now frozen on Triton's surface. Triton has a surface temperature of −235° C, the coldest known temperature in the solar system. Some volcanoes on Triton remain active, shooting crystals of nitrogen ice as high as 10 kilometres above the moon's surface. Nereid is much smaller than Triton, measuring only about 340 kilometres across. It travels in a long, elliptical orbit at an average distance of 5.6 million kilometres from Neptune.

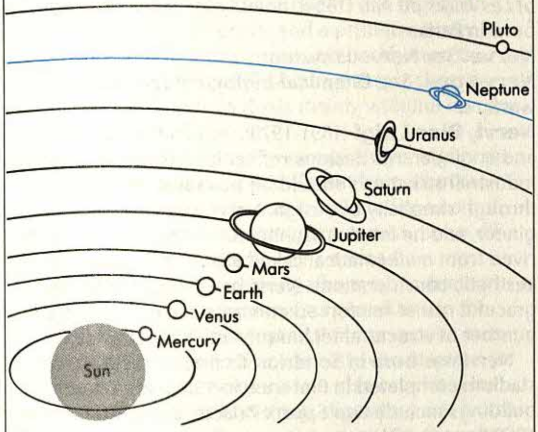
Neptune has three conspicuous rings and one faint ring. All of these rings are much fainter and darker than the rings of Saturn. They appear to consist of particles of dust. Neptune's outer ring is unlike any other planetary ring in the solar system. It has three curved segments that are brighter and denser than the rest of the ring. Scientists do not know why the dust is spread unevenly in the ring.

Satellites of Neptune

Designation	Mean distance from Neptune in km	Diameter of satellite in km	Year of discovery
1989 N6	48,000	54	1989
1989 N5	50,000	80	1989
1989 N3	53,000	150	1989
1989 N4	62,000	180	1989
1989 N2	74,000	190	1989
1989 N1	118,000	400	1989
Triton	355,000	2,705	1846
Nereid	5,513,000	340	1949

Neptune at a glance

Neptune, shown in blue in the diagram, is the eighth closest planet to the sun. The ancient symbol for Neptune is shown on the right.



Distance from the sun: *Shortest*—4,465,600,000 km; *Greatest*—4,546,100,000 km; *Mean*—4,504,300,000 km.
Distance from the earth: *Shortest*—4,313,000,000 km; *Greatest*—4,683,000,000 km.
Diameter: 49,500 km.
Length of year: About 165 earth-years.
Rotation period: 16 hours and 7 minutes.
Temperature: −214° C.
Atmosphere: Hydrogen, helium, methane, and acetylene.
Number of satellites: Eight.

Discovery. Neptune was discovered by means of mathematics before being seen through a telescope. Astronomers had noticed that Uranus, which they thought was the most distant planet, was not always in the position they predicted for it. The force of gravity of some unknown planet seemed to be influencing the motion and position of Uranus.

In 1843, John C. Adams, a young English astronomer and mathematician, began working to find the location of the unknown planet. Adams predicted the planet would be about 1.6 billion kilometres farther from the sun than Uranus. He completed his remarkably accurate work in September 1845. Adams sent it to Sir George B. Airy, the Astronomer Royal of England. But Airy did not look for the planet with a telescope. Apparently, he lacked confidence in Adams.

Meanwhile, Urbain J. J. Leverrier, a young French mathematician unknown to Adams, began working on the project. By mid-1846, Leverrier also had predicted Neptune's position. He sent his predictions, which were similar to those of Adams, to the Urania Observatory in Berlin, Germany. Johann G. Galle, the director of the observatory, had just charted the fixed stars in the area where the planet was believed to be. On Sept. 23, 1846, Galle and his assistant, Heinrich L. d' Arrest, found Neptune near the position predicted by Leverrier. Today, both Adams and Leverrier are credited with the discovery. The planet was named after Neptune, the Roman sea god. In August 1989, the *Voyager 2* spacecraft provided the first close-up views of Neptune and its satellites and rings.

See also **Planet; Solar system.**

Neptunium is an artificially created element with chemical symbol Np. Its atomic number is 93. Its most stable isotope has an atomic weight of 237 and a half-life of 2 million years (see **Radioactivity** [Half-life]). Neptunium was discovered by Edwin M. McMillan and P. H. Abelson at the University of California, U.S.A., in 1940. It was first produced by bombarding uranium with slow neutrons. Neptunium produced in this way is unstable and decays to form an isotope that can be used for nuclear fission. Scientists have created much neptunium in nuclear reactors and have studied its physical and chemical properties. Neptunium metal has a density of 20.25 grams per cubic centimetre at 20° C. It melts at 639° C.

Nereids were 50 beautiful sea nymphs who attended the sea divinities Poseidon and Amphitrite. They were the daughters of the sea goddess Doris and of Nereus, called the Old Man of the Sea. The Nereids lived under the sea and surfaced to dance in the waves. Their leader was Thetis, mother of the hero Achilles. Other famous Nereids included Psamathe and Galatea. See **Nereus; Andromeda.**

Nereus was a kindly old sea god in Greek mythology. The poets Homer and Hesiod called him the Old Man of the Sea.

Like other sea deities, Nereus had the gift of prophecy and the ability to change shapes. He foretold the fall of Troy in the Trojan War. The Greek hero Heracles (Hercules in Latin) captured him while he slept and held him fast as he rapidly changed forms. After Nereus finally resumed his original shape, he told Heracles where to find the garden of the Hesperides (see **Hesperides**). The hero then let him go. With the sea goddess Doris, Nereus fathered 50 lovely sea nymphs called the Nereids (see **Nereids**).

Neri, Saint Philip (1515-1595), was the founder of the Oratorians, and a reformer of Rome during the Counter Reformation. Pope Gregory XIII recognized his group of priests as the Congregation of the Oratory in 1575. Neri, a popular leader, also won over cardinals and popes to his unusual methods of reform. He was born in Florence, Italy.

Nerina, Nadia (1927-   ), a ballerina, won acclaim in many parts of the world for the brilliance of her dancing. She was the first ballerina of the Royal Ballet, a British ballet company, to appear with the Bolshoi and Kirov ballets in the Soviet Union. One of her greatest roles was Lise in *La Fille Mal Gardée,* which the choreographer Frederick Ashton created specially for her.

Nerina was born in Cape Town, South Africa. She studied ballet in London under Marie Rambert. Nerina joined the Sadler's Wells Ballet in 1946 and the Royal Ballet in 1947.

Nernst, Walther Hermann (1864-1941), a German physical chemist, won the 1920 Nobel Prize in chemistry for his formulation of the third law of thermodynamics (see **Thermodynamics**). His measurements of the specific heats of substances at low temperatures proved this law to be valid. Nernst was born in Briessen, Germany.

Nero (A.D. 37-68) was a Roman emperor who reigned from A.D. 54 until his death 14 years later. His rule is best known for a fire that destroyed much of Rome in A.D. 64. Nero built the Golden House, a colossal palace, in the centre of the burned-out area. There were rumours that Nero had started the fire so he could build the palace. But he blamed the Christians, then an unpopular group in Rome, and persecuted them.

Nero was born in Antium. His given and family names were Lucius Domitius Ahenobarbus. His father, Gnaeus Domitius Ahenobarbus, was a nobleman. Nero's mother was Agrippina the Younger, the great-granddaughter of Emperor Augustus. Nero's father died when Nero was still a child, and Agrippina married Emperor Claudius in A.D. 49. Claudius adopted Nero as his eldest son, naming him Nero Claudius Caesar Drusus Germanicus. In A.D. 53, Nero married Octavia, Claudius' daughter by a previous marriage. The next year, Claudius died. Many historians believe that Agrippina poisoned him so that Nero could become emperor.

At first, Nero permitted two respected advisers to direct state affairs. These advisers were Seneca, a philosopher and writer, and Burrus, a military officer. But Nero began to assume his own power in A.D. 59. That year, he had Agrippina murdered. In A.D. 62, Burrus died, and Seneca retired from political life. Soon afterward, Nero divorced Octavia and then had her killed so he could marry Poppaea Sabina. Nero killed her a few years later. He also executed many Roman senators because they questioned his actions. These executions and Nero's scandalous life made him increasingly unpopular with the upper classes. A plan to overthrow Nero failed, and more aristocrats were killed in A.D. 65.

Nevertheless, most of Rome's provinces were well governed and peaceful. Nero's military commanders put down rebellions in Britain and Judea and reasserted Rome's right to choose the king of Armenia.

In A.D. 68, the Greeks revolted against Nero's cruel regime. He took his own life soon afterward.

See also **Agrippina the Younger; Petronius, Gaius; Seneca, Lucius Annaeus.**

Neruda, Pablo (1904-1973), a Chilean poet, won the 1971 Nobel Prize for literature. Many critics consider Neruda the finest Latin-American poet of his time. His use of surrealistic, violent, subconscious imagery and highly personal symbols makes his poetry sometimes difficult to understand. His works communicate a sense of universal chaos.

Neruda was born in Parral, Chile. His real name was Neftalí Reyes. Several volumes of his poetry were published before he was 20. His volumes of poems include *Crepusculary* (1923), *Twenty Poems of Love and One Desperate Song* (1924), and *Residence on Earth* (1931, 1935). His *A New Decade: Poems (1958-1967)* was published in 1969. *Isla Negra,* a collection of autobiographical poems, was published in 1982, after his death. Neruda served in the Chilean diplomatic service as a consul and ambassador.

Nerval, Gérard de (1808-1855), was a French poet. His charm, odd behaviour, periodic mental disorders, and mysterious suicide made him a hero typical of the romantic movement. Critics consider him a major visionary poet.

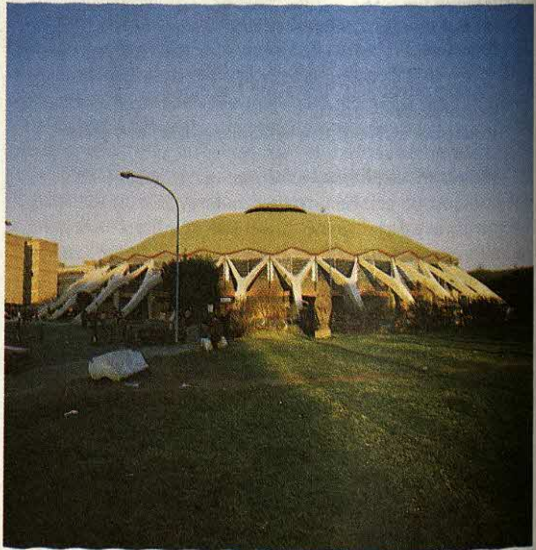
Nerval believed in *metempsychosis,* the passing of a soul at death from one body to another. In *Les Chimères* (1854), a collection of sonnets, this belief underlies many obscure references to the legendary past which contribute to the haunting beauty of the poems. His search for the eternal feminine ideal is reflected in the short stories of *Les Filles du Feu* (1854), notably in "Sylvie." He was born in Paris.

Nerve. See **Nervous system.**

Nerve gas. See **Chemical-biological-radiological warfare.**

Nervi, Pier Luigi (1891-1979), was an Italian architect and engineer. His designs reflect his belief that practical industrial structures should be beautiful and elegant through simplicity of design. Nervi was trained as an engineer, and he felt that architectural beauty could be derived from mathematical calculations rather than from aesthetic considerations. Nervi became noted for his graceful use of reinforced concrete. He developed a number of structural techniques utilizing concrete.

Nervi was born in Sondrio. His first major work was a stadium completed in Florence in 1932. Nervi's other buildings include two Sports Palaces designed for the 1960 Summer Olympic Games in Rome, and the Palace of Labour (1961) in Turin. For other pictures of Nervi's designs, see **Rome** (picture: The Sports Palace) and the introduction to **Architecture.**



Nervi's Little Sports Palace was designed for the 1960 Summer Olympics in Rome. The arena shows Nervi's skill in creating large-scale reinforced concrete structures.

Nervous breakdown is a term often used to refer to anything from fatigue caused by overwork to a severe mental illness. It has no precise medical meaning. Psychiatrists and others who study and treat mentally ill patients do not use the term. It is used by those who believe it is an accepted medical term, or who want to avoid using the term "mental illness." The original idea behind the term was that mental symptoms were caused by a failure of the nerves to function properly.

See also **Mental illness.**

Nervous system is an internal communications network that enables an animal to adjust to changes in its environment. Almost all animals, except the simplest kinds, have some type of nervous system.

Animals without a backbone have a nervous system that ranges from a simple net of nerves to a highly organized system of nerve cords and a primitive brain. In human beings and other animals with backbones, the nervous system consists of the brain, the spinal cord, and the nerves. This article deals mainly with the human nervous system.

The human nervous system—especially the highly developed brain—makes people different from all other animals. The human brain functions much like a complicated computer that enables people to speak, solve difficult problems, and produce creative ideas.

The nervous system provides pathways by which information travels from a person's surroundings to the brain. The brain then sends instructions to various muscles via other pathways so that the body can respond to the information. The nervous system also regulates internal functions, such as breathing, digestion, and heartbeat. All of a person's movements, sensations, thoughts, and emotions are products of his or her nervous system.

How the nervous system works

The nervous system is made up of billions of special cells called *neurons* or *nerve cells.* Cordlike bundles of neuron fibres are called *nerves.* The nerves form a network of pathways that conduct information rapidly throughout the body.

A person's reaction to a situation may take only an instant, but it involves many complicated processes within the nervous system. For example, what happens in the nervous system of a person who sees a wild tiger and, an instant later, turns and runs away?

Specialized neurons called *receptors* are located in the ears and eyes and the other sense organs of the body. The receptors translate events in a person's surroundings—such as the sight of a tiger—into nerve messages, which are known as *impulses.* Nerve impulses travel along nerve fibres at speeds of 1 to 90 metres per second.

The receptor cells in the eyes respond to light rays that reflect off the tiger and translate the rays into a pattern of nerve impulses. These impulses then travel through neurons called *sensory neurons* and *association neurons.* The sensory neurons carry information from receptors in the sense organs to the association neurons, which are located in the brain and within the spinal cord.

The neurons in the brain receive the impulses, analyse and interpret the message, and decide what action should be taken. A message consisting of the sight of a wild tiger is, of course, interpreted as danger. The person's brain immediately sends out a message—"Run!"—in the form of nerve impulses.

Next, the impulses travel through *motor neurons.* These nerve cells carry messages from the brain to the muscles and glands, which are called *effectors.* The effectors carry out the brain's instructions. Thus, the leg muscles respond and the person runs away. At the same time, the brain sends messages to various other parts of the body. For example, it sends messages to the heart to beat faster and send more blood to the leg muscles.

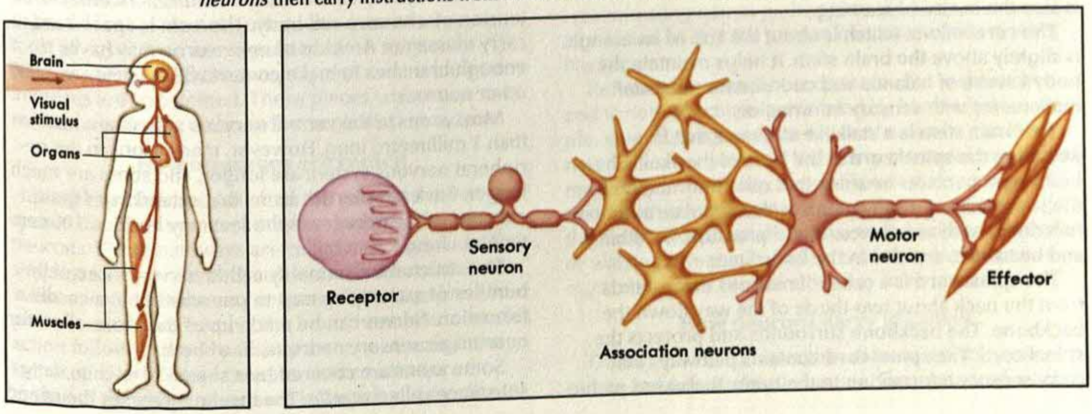
Divisions of the nervous system

The nervous system has three main parts, the *central nervous system,* the *peripheral nervous system,* and the *autonomic nervous system.* Each of these parts has special functions.

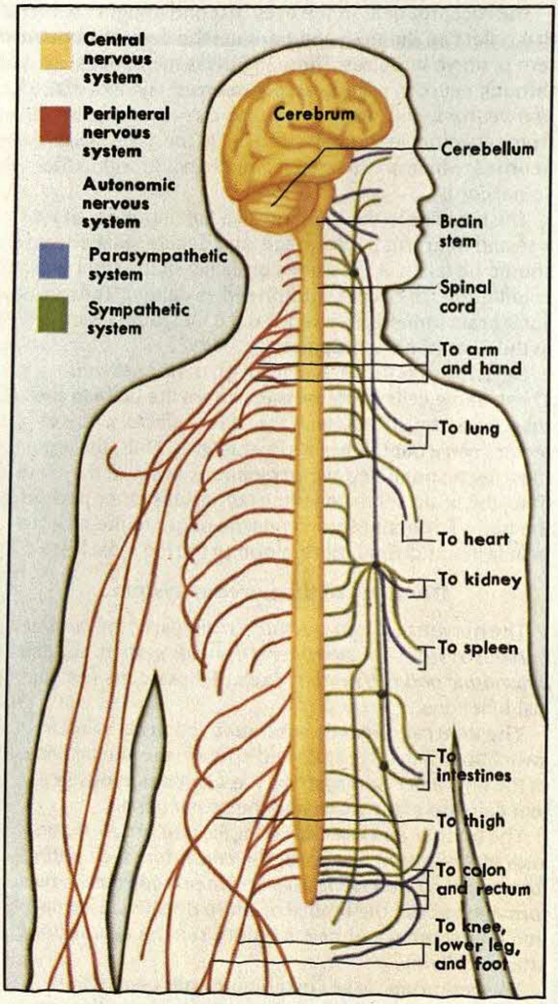
The central nervous system functions as a "main switchboard" that controls and coordinates the activities of the entire nervous system. The central nervous system consists of the *brain* and the *spinal cord.*

The brain is an extremely complicated organ. It consists of three principal parts, the *cerebrum,* the *cerebellum,* and the *brain stem.* This article provides basic information about the brain. For more detailed information on the brain and how it works, see the *World Book* article on **Brain.**

The cerebrum makes up about 85 per cent of the brain and is the most complex part. It is above the cerebellum and the brain stem and almost surrounds them. Human beings have a highly developed cerebrum that directs their hearing, sight, and touch and their ability



How the nervous system works The nervous system enables us to adjust to changes in our surroundings. Such *neurons* (nerve cells) as the *receptors* in the eyes translate information from the environment into nerve impulses. *Sensory neurons* carry the impulses to *association neurons* in the brain and spinal cord. *Motor neurons* then carry instructions from the brain to muscles, internal organs, and other body parts.



The human nervous system has three main parts: (1) the *central nervous system,* (2) the *peripheral nervous system,* and (3) the *autonomic nervous system,* which consists of *sympathetic* and *parasympathetic* divisions. This simplified diagram shows only major nerves. It illustrates peripheral nerves only on the left side of the figure and autonomic nerves only on the right.

to think, use language, and feel emotions. The cerebrum is also the centre of learning.

The cerebellum, which is about the size of an orange, is slightly above the brain stem. It helps maintain the body's sense of balance and coordinates muscular movements with sensory information.

The brain stem is a stalklike structure that is connected to the spinal cord at the base of the skull. The brain stem contains neurons that relay information from the sense organs. Many neurons that regulate automatic functions, such as balance, blood pressure, breathing, and heartbeat, are also in the brain stem.

The spinal cord is a cable of neurons that extends from the neck about two-thirds of the way down the backbone. The backbone surrounds and protects the spinal cord. The spinal cord contains pathways that carry sensory information to the brain. It also has pathways that relay commands from the brain to the motor neurons.

The peripheral nervous system carries all the messages sent between the central nervous system and the rest of the body. The peripheral nervous system consists of 12 pairs of nerves that originate in the brain, plus 31 pairs of nerves of the spinal cord. These cranial and spinal nerves serve as "telephone wires" that carry messages to and from every receptor and effector in the body.

The autonomic nervous system is a special part of the peripheral nervous system. The autonomic nervous system regulates such automatic bodily processes as breathing and digestion without conscious control by the brain. This constant regulation enables the body to maintain a stable internal environment.

The autonomic nervous system has two parts, the *sympathetic system* and the *parasympathetic system.* The sympathetic system responds to the body's needs during increased activity and in emergencies. The actions of the sympathetic system include speeding up the heartbeat, sending additional blood to the muscles, and enlarging the pupils of the eyes to use all available light.

The parasympathetic system, in general, opposes the actions of the sympathetic system. The parasympathetic system's functions include slowing down the heartbeat, diverting blood from the muscles to the stomach and intestines, and contracting the pupils of the eyes. The balance of activity between the two systems is controlled by the central nervous system.

Parts of a neuron

A neuron has three basic parts, the *cell body,* the *axon,* and the *dendrites.* A thin *nerve membrane* surrounds the entire cell.

The cell body of a neuron is a ball-shaped structure about 0.025 millimetre wide. Each neuron cell body is a centre for receiving and sending nerve impulses. The cell body is also responsible for making proteins and using energy for the maintenance and growth of the nerve cell.

The vast majority of neuron cell bodies are within the central nervous system, where incoming messages are combined and outgoing messages are produced. The few neuron cell bodies outside the central nervous system are grouped into clusters called *ganglia.* The best-known ganglia are in the autonomic nervous system.

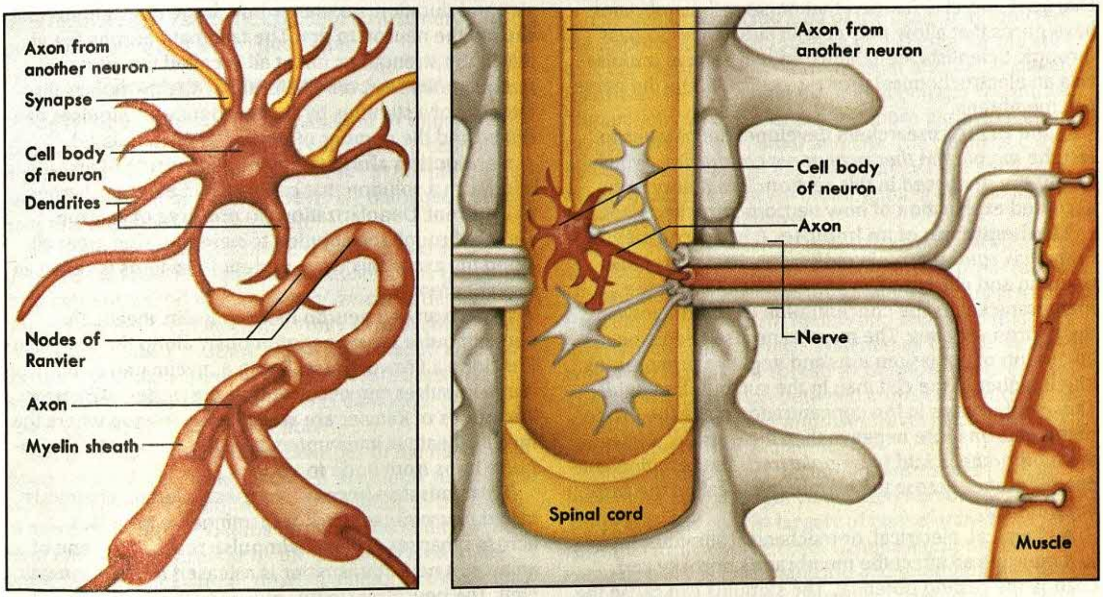
The axon, also called the *nerve fibre,* is a tubelike extension of a neuron cell body. The axon is specialized to carry messages. An axon of one neuron may have enough branches to make contact with as many as 1,000 other neurons.

Most axons in the central nervous system are less than 1 millimetre long. However, many axons in the peripheral nervous system are longer, and some are much longer. For example, the axons that extend from the spinal cord to the muscles in the feet may be 75 to 100 centimetres long.

The structures commonly called *nerves* are actually bundles of axons lying next to one another in a cordlike formation. Nerves can be made up of the axons of motor neurons or sensory neurons, or of both.

Some axons are covered by a sheath of a white, fatty substance called *myelin.* The myelin increases the speed

Neurons and nerves A neuron, *left,* has three basic parts. The *cell body* serves as the control centre for the cell's activities. The *axon* is a tubelike extension that carries messages. The *dendrites* are shorter extensions specialized to receive messages. A nerve, *right,* consists of a cordlike bundle of axons from several neurons. The nerve shown runs from the spinal cord to a muscle.



of impulses along the axons. Myelin also causes the distinction between the *grey matter* and *white matter* in the nervous system. Grey matter consists largely of *unmyelinated axons* (axons without myelin sheaths) and neuron cell bodies. White matter is made up mostly of axons that have white sheaths of myelin. Myelin is formed in the peripheral nervous system by *Schwann cells,* which are special supporting cells that surround the axons. In the central nervous system, supporting cells called *glia* produce myelin.

The dendrites of a neuron are branching, tubelike extensions of the cell body that form a pattern resembling the limbs of a tree. Most neuron cell bodies have about six main dendrites, each of which is two or three times as thick as the axon of the cell. The distance between the cell body and the tips of the dendrites is about 0.5 millimetre.

Dendrites are specialized structures for receiving impulses, mostly from the axon of another neuron. Dendrites and axons do not quite touch each other. In almost all cases, they are separated by an extremely narrow space called the *synaptic cleft,* over which nerve impulses are transmitted. These places where one neuron communicates with another are called *synapses.*

How messages are routed

Simple pathways. Much of the work of the nervous system depends upon established pathways between neurons. These pathways are called *neural circuits.* The simplest kind of neural circuit is a *reflex.* A reflex is an automatic and involuntary response to a stimulus. Simple reflexes do not involve the brain. Impulses in a reflex action follow a simple pathway that goes through the spinal cord and links a receptor and an effector.

One of the simplest reflexes is the *knee jerk reflex.* A tap on the tendon below the kneecap stretches the muscle there, and this action stimulates special receptors to produce an impulse. The impulse travels through a sensory neuron, over an axon to the spinal cord, and through a synapse to a motor neuron. There, a second impulse is generated. The second impulse travels over the axon of a motor neuron back to the muscle that was stretched. The impulse causes the muscle cells to contract and the leg to jerk.

Complex pathways. Many reflexes are more complicated. They involve at least one association neuron between the sensory and motor neurons. The association neuron, in turn, may be connected with many complex neural pathways, some of which may lead to the brain. A common but complex reflex is involved in withdrawing from a painful stimulus. For example, if a person steps on a sharp object, the immediate response is to lift the foot. In addition, association neurons stimulate the muscles of the other leg to adjust and maintain balance. Interconnecting neural pathways to the brain also may be stimulated so that the person becomes aware of what has happened.

Reflexes alone cannot account for the vast number and variety of actions performed by human beings. People, as well as some other kinds of animals, can learn new behaviour patterns. Voluntary muscular movements necessary for learning new skills travel along complex nerve pathways that extend from the brain throughout the body. Complicated actions, such as riding a bicycle or walking, eventually can be performed without constant, conscious control after they have been learned.

How neurons carry impulses

During the 1800's, scientists discovered that nerve impulses involve electrical charges. They assumed a nerve impulse was simply an electric current flowing through nerves. By the 1900's, researchers had learned that different concentrations of certain ions in neurons and in their surrounding fluids create a potential electrical charge. It was also learned that nerve cell membranes have pores that allow only certain substances to pass through. Scientists then theorized that a nerve impulse was an electrochemical process controlled by the nerve cell membrane.

In the 1930's, researchers developed techniques to test the *membrane theory of nerve conduction,* which is the theory discussed in this section. This theory is the accepted explanation of how neurons carry impulses.

The beginning of an impulse. A nerve cell membrane has special protein molecules that control the opening and closing of its pores. When at rest, the membrane keeps the concentration of sodium ions in the neuron very low. The membrane also keeps the concentration of potassium ions and negative organic ions much higher in the cell than in the surrounding fluids. These differences in ion concentration make the inside of the neuron more negative than the outside, and so the membrane is said to be *polarized.* The resulting voltage difference across the membrane is called the *resting potential.*

A chemical, electrical, or mechanical stimulus applied to a neuron can affect the membrane's porosity and change the resting potential. The stimulus can cause the membrane's pores to open and allow more sodium ions into the cell. The increase in sodium ions makes the inside of the cell positively charged, and this voltage change is called a *depolarization.*

When a stimulus causes a neuron to depolarize, the neuron is said to *fire.* The firing of a neuron is the beginning of a nerve impulse. A stimulus must be of a certain intensity, called the *threshold voltage,* for a neuron to fire.

All impulses from a particular neuron have the same size and duration, no matter how large the stimulus that caused the neuron to fire. The fact that neurons fire at maximum strength or not at all is called the *all-or-nothing phenomenon.* The brain probably detects the intensity of a stimulus by the frequency of impulses generated and the number of nerve fibres stimulated.

Conduction along the axon. The inside of an axon is filled with a solution that can conduct electric charges as a current. Depolarizations in one area of an axon spread through the solution to neighbouring areas all along the axon. This wave of depolarizations is called an *action potential.*

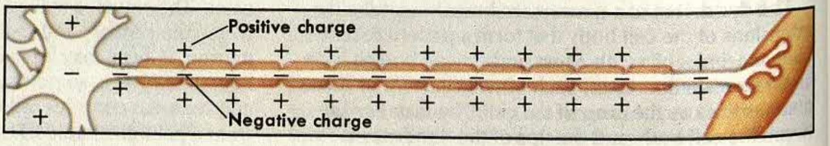
If the axon of a neuron has no myelin sheath, the nerve impulse sweeps continuously along the axon, like fire along a firework fuse. But in a myelinated axon, nerve impulses can occur only at the *nodes of Ranvier.* The nodes of Ranvier are areas along an axon where the myelin sheath is interrupted at regular intervals. The impulse hops from node to node.

Transmission across synapses. Certain chemicals, called *neurotransmitters,* transmit nerve impulses across synapses. When an impulse reaches the end of an axon, a neurotransmitter is released into the synaptic cleft. The neurotransmitter moves to the dendrites of the next nerve cell and causes certain pores of the nerve membrane to open. Ions move through these pores, and a voltage change, called a *postsynaptic potential,* results.

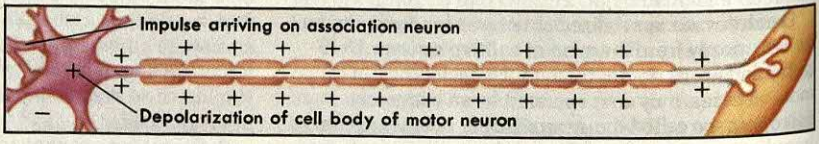
The postsynaptic potential is either *excitatory* or *inhibitory.* An excitatory postsynaptic potential spreads to the axon of a nerve cell and tends to produce another

Transmission of a nerve impulse The transmission of a nerve impulse is an electrochemical process. Most experts believe the neuron membrane controls this process by selectively allowing ions to enter and leave the cell. These diagrams show how a motor neuron carries a message from an association neuron to an effector.

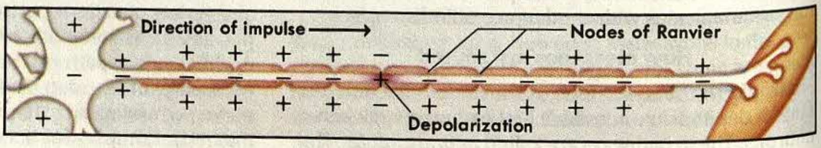
A resting neuron is *polarized*—that is, its inside is more negative than its outside. The membrane maintains the polarity by restricting the flow of ions in and out of the cell.



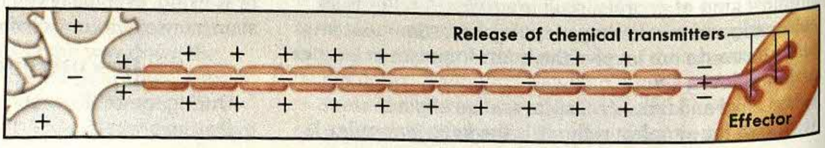
The impulse begins when neurotransmitters from the association neuron change the porosity of the motor neuron's membrane. This change results in depolarization.


Impulse arriving on association neuron
Depolarization of cell body of motor neuron

The impulse spreads down a myelinated axon as the depolarization hops from one node of Ranvier to the next. The impulse shown has gone nearly halfway down the axon.



Chemical transmitters are released by specialized structures when the impulse gets to the neuron's end. These chemicals stimulate the effector, in this case a muscle.



action potential. An inhibitory postsynaptic potential tends to prevent the axon from producing another action potential. Not every impulse that reaches a synapse is transmitted to the next neuron. The synapses thus help regulate and route the constant flow of nerve impulses throughout the nervous system.

Disorders of the nervous system

The nervous system can be damaged by injury and disease. Axons in the central nervous system cannot regrow after being damaged, but nerves in the peripheral nervous system may recover. Severely damaged nerve cells that die cannot be replaced.

Most neurons that perform a specific job are grouped together in the brain. Because of this grouping arrangement, called *localization of function,* damage to one area of the brain may affect only certain abilities and leave others intact. In some cases, undamaged areas of the brain gradually assume control of functions lost when another area of the brain was damaged. This action is called *recovery of function.*

The most common serious disorder of the nervous system is *stroke.* A stroke occurs if the blood supply to a certain area of the brain is cut off, resulting in the death of nerve cells. Stroke victims may lose the ability to perform functions controlled by the damaged area of the brain, such as speaking or moving a limb. Stroke victims may eventually recover some lost functions. But if respiration or some other vital function is affected, a stroke can be fatal.

The most common infectious diseases that affect the nervous system are mild virus infections that last only a few days and may produce headaches. More serious infectious diseases, such as *encephalitis* and *meningitis,* are caused by certain bacteria, viruses, or other microbes. Encephalitis is an inflammation of the brain, and meningitis is an inflammation of the membranes covering the brain and the spinal cord. See **Encephalitis; Meningitis.**

The cause of *multiple sclerosis,* a disease of the nervous system, is not known. Multiple sclerosis causes axons in various areas of the central nervous system to lose their myelin sheaths. As a result, these axons cannot conduct nerve impulses properly.

Another disorder of the nervous system is *epilepsy.* Victims of epilepsy suffer seizures that can cause muscle convulsions and a change in, or loss of, consciousness. An epileptic seizure occurs if most of the neurons in one area of the brain produce bursts of impulses at the same time. Doctors prescribe drugs to reduce the number of seizures or to prevent them completely.

Before the development of vaccines to prevent *poliomyelitis,* this virus disease of the nervous system was widespread. The polio virus can destroy motor neurons in the spinal cord and brain stem, leading to paralysis in some cases.

Some disorders of the nervous system can lead to mental illness or mental retardation. For information about these conditions, see the articles on **Mental illness** and **Mental retardation.**

The nervous system in other animals

In vertebrates. All vertebrates, including other mammals, as well as amphibians, birds, fish, and reptiles, have nervous systems much like the human nervous system. The neurons that make up the nervous systems of these animals are about the same size and shape as human neurons.

The size of a specific area of the brain may indicate the importance of the function of that area for the animal. For example, dogs have a larger and better developed area for smell than do human beings. In contrast, human beings have a larger and more highly developed *cerebral cortex* than other animals. The cerebral cortex is the outer surface of the cerebrum, where such complicated skills as delicate motor control and the use of language are coordinated.

In invertebrates. Most species of invertebrates that consist of more than one cell have some sort of nervous system. Many of the neurons of these animals are larger than human neurons. In hydras and some other simple invertebrates, the nervous system may be a *nerve net,* in which nerve cells are spread throughout the organism. There is no distinction between axons and dendrites in nerve net systems, and impulses travel in all directions from the point of stimulation.

Other invertebrates, including worms and insects, have more complicated, centralized nervous systems. These systems consist largely of concentrations of neurons that form a nerve cord. Ganglia along the cord serve as centres for organizing and integrating various activities of the animals. Clusters of ganglia in the front end of the body act as a primitive "brain." Many insects also have such ganglia in the thorax region. These ganglia coordinate motor activities. The mechanisms of nerve impulses and synaptic potentials in higher invertebrates are the same as those in the human nervous system.

Related articles in ***World Book*** include:

Amyotrophic lateral sclerosis
Bell's palsy
Biofeedback
Brain
Cerebrospinal fluid
Depressant
Epilepsy
Heart
Human body
Huntington's disease
Multiple sclerosis
Neuritis
Neurofibromatosis
Neurology
Palsy
Paralysis
Parkinson's disease
Plexus
Poliomyelitis
Prion
Reflex action
Sciatica
Senses
Shingles
Spine
Stroke
Tay-Sachs disease
Tourette syndrome

Nesbit, Edith (1858-1924), was an English novelist, poet, and writer of stories for children. The best-remembered of her children's stories are *The Treasure Seekers* (1899), *Five Children—and It* (1902), and *The Railway Children* (1906). Her novels and poems never gained as much recognition as her stories for children. Edith Nesbit was born in London.

Ness, Loch. See **Loch Ness monster.**

Nest is a place an animal prepares for raising its young. See **Animal** (Animal homes); **Ant** (Nests); **Bee** (The honeybee colony); **Bird** (Building a nest; pictures: Kinds of bird nests); **Bird's-nest soup; Hornet; Squirrel** (Homes); **Wasp.**

Nestor. See **Messenia.**

Nestorian Christians are members of a religious sect that was prominent in the A.D. 400's. They follow the teachings of Nestorius, who was bishop of Constantinople. They believe that Jesus united in Himself two persons: the Word and the man. But these two persons were so closely united that they could almost be regarded as one. Nestorian doctrine does not recognize Mary as the mother of God. It teaches instead that Mary gave birth to a man who was the *instrument* of divinity, but was not divinity itself.

In A.D. 431, a Roman synod condemned Nestorius. He eventually died in exile. The sect continued to flourish in Arabia, Syria, and Palestine, and had missions in China, India, and Egypt. But it split into two groups in the 1500's. One group, now known as the Chaldean Christians, transferred its allegiance to the Roman Catholic Church. The other group maintained its old traditions.

Net is an open fabric. It is produced by knotting or looping together yarns, cords, wires, or other materials so that there are spaces left between the points where the material intersects. Today, most nets are made of cotton, nylon, or polyester, but some nets are made of silk.

There are many kinds of nets and they have a wide variety of uses. For example, such household items as curtains, hammocks, tablecloths, and bedspreads are often made of net. Many sports, including tennis, volleyball, basketball, hockey, and soccer, feature nets. A type of light, fine net called *tulle* is used in ballet costumes and in veils. Cargo is often loaded onto ships by means of coarse, heavy nets. Heavy nets also play an important role in the fishing industry. Some fishing nets weigh as much as 4,500 kilograms and are as long as 600 metres.

It is thought nets were first made about 13,000 years ago. Early societies made nets by hand from a variety of vegetable fibres such as bark, cotton, and coconut, or from animal tissues. They used the nets primarily to catch fish and keep hair in place. Nets continued to be handmade until the mid-1700's, when they began being manufactured on warp-knitting machines. These devices knit lengthwise stitches and produce a flat fabric. Today, most nets are made on bobbinet machines or raschel knitting machines.

See also **Fishing industry** (How fish are caught); **Lace**; **Textile** (Kinds of fabrics).

Some kinds of nets Nets range from light, delicate *tulle* to heavy, coarse cargo nets and fishing nets. The photographs below show various nets being used in work and leisure activities.

Tulle ballet skirt

Volleyball net

Cargo net

Fishing net

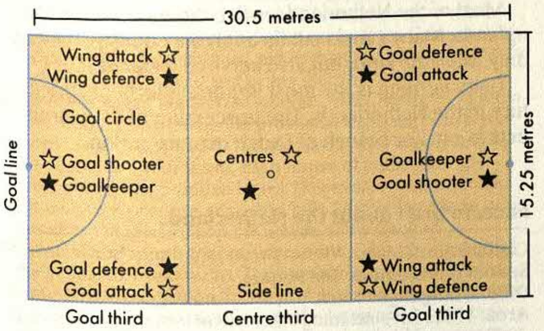
Netball is a game for single-sex competition, played mainly by women and girls. Two teams, each of seven players, take part in a match. The players of each team pass the ball among themselves by throwing or bouncing it. The players in each team try to get the ball into a half-circle, called a goal circle, at the end of the court that they are attacking. They pass it to one of the two players in the team who may shoot a goal. One of these two players—called goal shooter and goal attack—scores a goal when she throws the ball so that it passes downwards through a ring about 3 metres from the ground. The team scoring the greater number of goals wins.

Netball court and equipment. Court surfaces should be hard, but the material used varies among countries. Asphalt is the best material. The court is divided into thirds—two *goal thirds* and a *centre third.* The goal circles are in the goal thirds, and are 9·75 metres in diameter. The centre circle is in the centre third, and is 0·914 metre in diameter.

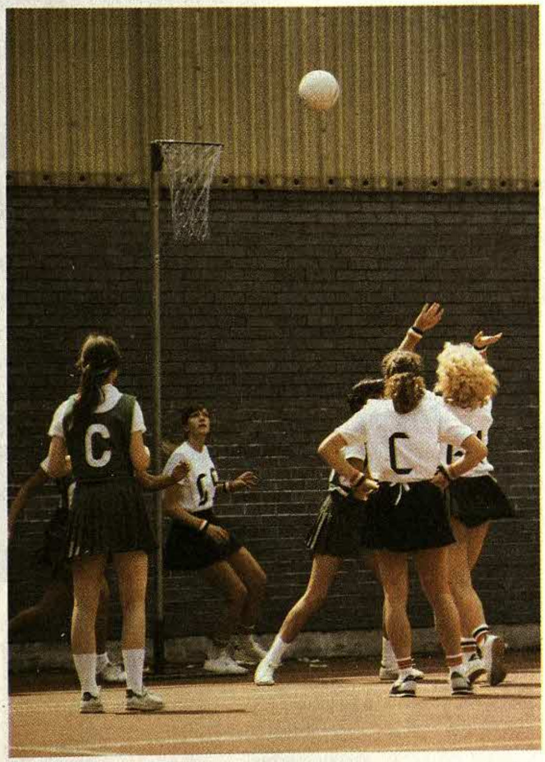
The goal posts, which may be made of wood, metal, or concrete, stand on the middle of each goal line. The ball is made of leather or moulded rubber. It is from 685 to 710 millimetres in circumference and weighs 395 to 455 grams. It should be firmly inflated.

The game. An international match lasts for one hour and is divided into four periods called *quarters.* In school and club matches, a match may consist of two *halves,* each of 20 minutes. There are seven players in a team: goal shooter, goal attack, wing attack, centre, wing defence, goal defence, and goalkeeper. Players may play only in specific areas according to their positions. Players are penalized if they enter the wrong area. Two umpires control the game and decide whether any rules have been broken.

The game begins with a centre pass from one centre player, who stands in the centre circle. Before play starts, all players except the centre with the ball may move. But the centre who does not have the ball may move only within the centre third, and the other players only within the goal thirds. To begin the game, the centre with the ball passes it to another player in her team, who must catch or touch the ball in the centre third. The game is restarted with a centre pass after each goal is scored, and after an interval. The two centre players take turns making these centre passes throughout the game.



Attacking play. The team with control of the ball is attacking. The players run and dodge into spaces so that they can make a series of passes toward their goal. They may throw or bounce the ball to any member of their team, in any direction, but they may not pass it over two of the lines that divide the thirds. The player receiving the ball must be within her own area. Players may not run with the ball, nor hold the ball for longer than three seconds. The aim is for the goal shooter or goal attack to receive the ball in the shooting circle, shoot at goal, and score.


To score goals, one of the two attacking players who can enter the shooting circle throws the ball through the ring.

Defensive play. The team not in possession of the ball is defending. There are two main methods of defence. One method is to *mark* an opponent and prevent her from getting free or receiving a ball thrown to her. The other method is to intercept an opponent's throw or shoot at goal. Players may not make personal contact with an opponent nor come within 0·9 metre of an opponent who has the ball. The penalty for this offence is a penalty pass or shot.

History. Netball was invented in the United States as an indoor exercise. It was taken to England where it became popular in the late 1900's.

The All England Netball Association was formed in 1926. Its headquarters are in Hitchin, Hertfordshire, England. The International Federation of Netball Associations formulated international rules in 1960. These were amended and simplified in 1975, and are revised every 7 to 8 years. The Federation, which has more than 30 members, organizes a world tournament every four years. Teams from Australia and New Zealand have been outstandingly successful in these world championships.

Canals add to the scenic beauty of Amsterdam and other cities in the Netherlands. They also serve as waterways and help drain the country's low-lying land.

Netherlands

Netherlands is a small country on the North Sea in northwestern Europe. The Netherlands is often called *Holland,* though this name actually refers to only one part of the country. The people of the Netherlands call themselves *Hollanders* or *Nederlanders.* However, in English-speaking countries, the people are known as the *Dutch.*

"God created the world, but the Dutch created Holland," according to an old Dutch saying. More than two-fifths of the country's land was once covered by the sea, or by lakes or swamps. The Dutch "created" this land by pumping out the water. In these drained areas, called *polders,* are the richest farmlands and largest cities of the Netherlands. Amsterdam, the capital and largest city, is on a polder. Buildings in Amsterdam stand on wooden or concrete piles (posts) driven deep into the soggy ground. The Netherlands is famous for its many canals. In Amsterdam, the land is drained by more than 100 canals.

To make a polder, the Dutch build a dyke (also spelled *dike*) around the area to be drained of water. The water is pumped into a series of canals that flow into the North Sea. Windmills were once used to run the pumps, but electric motors have replaced most of them. Most of the polders are below sea level, so they have no natural drainage. As a result, the pumping must be continued after the polders are built.

The Zuider Zee, once a large bay, was cut off from the sea in 1932 by a dyke 32 kilometres long. This development changed the Zuider Zee into a freshwater lake called the IJsselmeer. Since then, much of the lake has been drained to make several large polders. This project has added 1,838 square kilometres of land for new farms and cities.

The people of the Netherlands have great pride in their long battle against the sea. They take extreme care to protect their hard-won land, and are famous for keeping their homes, towns, and fields clean and neat. Land is especially valuable to the Dutch because the Netherlands is one of the most densely populated countries in the world.

Most of the Netherlands is flat, though it has some uplands. Many canals cut through the country. They not only drain the land, but also serve as waterways.

Dairy farming is the most important form of agriculture in the Netherlands. The processing of dairy products is a major branch of Dutch manufacturing.

Facts in brief about the Netherlands

Capital: Amsterdam.
Seat of government: The Hague.
Official language: Dutch.
Area: 41,523 km², including 7,929 km² of inland water. *Greatest distances*—north-south, 315 km; east-west, 269 km. *Coastline*—367 km.
Elevation: *Highest*—Vaalser Berg, 321 m above sea level. *Lowest*—Prins Alexander Polder, 6.7 m below sea level.
Population: *Estimated 1996 population*—15,612,000; density, 376 people per km²; distribution, 89 per cent urban, 11 per cent rural. *1971 census*—13,060,115. *Estimated 2001 population*—16,181,000.
Chief products: *Agriculture*—flowers and flower bulbs, pigs, milk, potatoes, sugar beet, wheat. *Manufacturing*—chemicals, dairy products, electronic equipment, iron and steel, petroleum products, processed meats, transportation equipment. *Mining*—natural gas, petroleum, salt.
National anthem: "Wilhelmus van Nassouwe" ("William of Nassau").
Money: *Currency unit*—guilder. One guilder = 100 cents.

Government

The Netherlands is a constitutional monarchy. It has a democratic government that is based on the Constitution of 1814. The Constitution establishes a king or queen as the head of state, but gives the monarch little real power. The monarch names all appointed government officials on the advice of various government bodies. The monarch also signs all laws that are passed by the parliament.

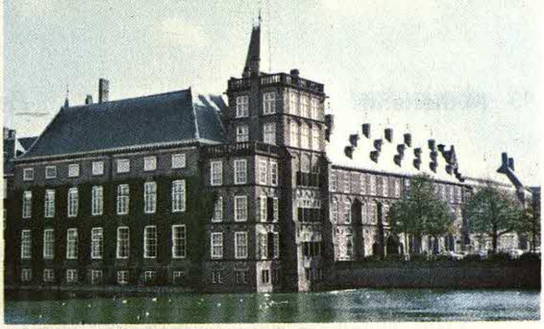
A queen has served as the monarch of the Netherlands since 1890, when King William III died. Queen Beatrix became the monarch in 1980. She replaced Queen Juliana, her mother, who retired. Dutch monarchs, unlike those of other countries, are not crowned. Instead, they are inaugurated.

The national government of the Netherlands meets in The Hague, though the capital is Amsterdam, which is 55 kilometres away. Invading French troops captured Amsterdam in 1795 and made it the capital. The Dutch restored their government in The Hague in 1814. The Hague houses the International Courts of Justice.

The Netherlands is part of the Kingdom of the Netherlands. The kingdom also includes the Netherlands Antilles—two groups of islands in the Caribbean Sea—and the island of Aruba, which is also located in the Caribbean Sea. These islands formerly made up a Dutch colony. Both the Netherlands Antilles and Aruba have an appointed governor and a Cabinet headed by a prime minister. Both Cabinets are responsible to a one-house legislature, whose members are elected by the people of the islands.

Government in brief

Form of government: Constitutional monarchy.
Political divisions: 12 provinces.
Head of state: King or queen.
Head of government: Prime minister, appointed by the monarch. The prime minister heads a Cabinet, also appointed, which runs the government departments. If the Cabinet and the parliament cannot agree, either the Cabinet resigns, or the parliament is dissolved and a new election is held.
Parliament (called the States-General): *First Chamber*—75 members, who are elected by the provincial legislatures to 6-year terms; *Second Chamber*—150 members, who are elected by the people to 4-year terms. Each house of parliament approves or rejects proposed laws. However, only the Second Chamber can propose or amend bills. Legislation is also proposed by the monarch on the advice of the Cabinet.
Provincial and municipal government: Councils elected by the people to 4-year terms. The number of members varies according to population. In the provinces, the chief executive is an appointed commissioner. In the cities and towns, the chief executive is an appointed burgomaster. Chief executives both in provinces and in cities and towns are appointed by the monarch.
Courts: All judges are appointed by the monarch for life. They can be removed from office only by the highest court, the High Court of the Netherlands. The High Court has 17 judges and consists of three chambers—for civil, criminal, and tax cases.
Voting age: 18.
Political parties: Christian Democratic Appeal, Labour Party, People's Party for Freedom and Democracy (also called Liberal Party).
Armed forces: Army, navy, and air force, with a total of about 105,000 men and women. Men are required to serve from 14 to 17 months in the armed forces after reaching the age of 19.



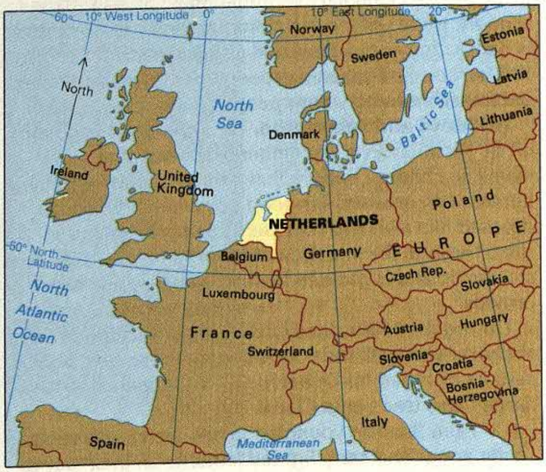
Parliament buildings in The Hague are the home of the two houses of the States-General, the Dutch parliament.

The Dutch flag dates from about 1630. Until then, an orange stripe was at the top instead of a red one.

The coat of arms has old symbols of the Dutch royal family. The sword and arrows represent strength in unity.

Queen Beatrix is the Dutch head of state. Her husband, Claus von Amsberg, *right,* became Prince Claus of the Netherlands after their marriage.

The Netherlands is about the same size as Switzerland.



People

The Netherlands is one of the most densely populated countries in the world. It has more than 450 people per square kilometre. Nevertheless few areas ever seem to be overcrowded. The Dutch keep their tidy homes, busy cities, and small farms as neatly arranged and sparkling clean as possible.

The Netherlanders are known for their good fellowship, called *gezelligheid.* This cosy friendliness, as well as Dutch orderliness, helps make life pleasant in the thickly populated country. The Dutch enjoy family gatherings to celebrate such occasions as birthdays and anniversaries. When families or friends gather, rich chocolates and pastries are often served.

The Dutch carry on their continuous battle against the sea—to "create" land and protect it from flooding—with courage and attentiveness. Perhaps because of the small size of their country, the Dutch are interested in the events of foreign countries. Almost all the people speak at least one foreign language.

Population. About 9 out of every 10 people in the Netherlands live in urban areas. For the total population of the Netherlands, see the *Facts in brief* table with this article.

About 40 per cent of the people in the Netherlands live in two coastal provinces—Noord-Holland (North Holland) and Zuid-Holland (South Holland). In these provinces are the three largest Dutch cities—Amsterdam, Rotterdam, and The Hague. Fourteen other cities have populations above 100,000. See the separate articles on the Dutch cities listed in the *Related articles* at the end of this article. Almost all of the people in the Netherlands are of Dutch ancestry. The largest non-Dutch groups include people from Indonesia, Morocco, Suriname, and Turkey.

Religion. Roman Catholics and Protestants each make up about 35 per cent of the Dutch population. The majority of Protestants belong to the Dutch Reformed Church. Members of the royal family traditionally belong to this church, but it is not an official state church. About a quarter of the Dutch are not members of any church.

Traditionally, Protestants, Catholics, and non-church members organized their lives to remain as separate as possible. This voluntary segregation involved separate schools, trade unions, farm organizations, newspapers, broadcasting companies, and political parties. Since the 1950's, the segregation has been slowly breaking down, particularly among young people.

Holidays and recreation. The Dutch exchange gifts on St. Nicholas' Eve, December 5, instead of at Christmas. The children believe that Saint Nicholas visits their homes with presents for good boys and girls. A man dressed like a bishop represents Saint Nicholas and rides through the streets. In Amsterdam, he arrives by steamship and is greeted by ringing bells and cheering crowds.

During the 1600's, the Dutch took the custom of Saint Nicholas' visit with them to America. There, the English settlers changed his Dutch nickname, *Sinterklaas,* to *Santa Claus* (see **Santa Claus**).

On Palm Sunday, young people in Dutch villages sing Easter songs and carry lighted lanterns on their way to the market place for music and dancing. On Easter Sunday, children and adults play games with coloured eggs. Many sports events are held on Easter Monday.

The Dutch celebrate Queen's Day, the birthday of former Queen Juliana, on April 30 with local parades, games, and flea markets. Most towns hold a *kermis* (fair) with carnival attractions and other entertainment.

The people of the Netherlands are famous for growing tulips and other bulb flowers, and they hold many spectacular flower festivals each spring. Long parades of floats covered with blue, pink, red, and yellow blossoms wind through the towns near the bulb fields. Homes and lawns along the way are also decorated with beautiful floral designs.

The canals that carry water from the land are also used for ice skating, an extremely popular sport. But the Netherlands has mild winters, and the people do not have thick ice for skating as often as they would like. When the ice is hard enough, schools sometimes close to let the children skate. The Dutch greatly enjoy watching the *Elfstedentocht.* The Elfstedentocht is an ice-skating race held on the canals of the northern province of Friesland if the ice is hard enough. The 200-kilometre racing course connects all 11 cities of the province.

Clothing. Most Netherlanders wear clothing similar to that worn in most other Western countries. People in farm areas and fishing villages sometimes wear the famous Dutch wooden shoes called *klompen.* These shoes are noisy, but they protect the feet from damp earth better than leather shoes do. The Dutch do not wear wooden shoes in their homes. They leave them outside and change to leather shoes.

Dutch national costumes also include full trousers for the men, and full skirts and lace caps for the women. They are still worn in a few regions, including the islands of Zeeland, the coastal fishing communities, and the towns of Staphorst and Spakenburg. See **Clothing** (picture: Traditional costumes).

Language. The Dutch language is part of the Germanic language group. Many English words, including *brandy, skate, skipper,* and *yacht,* have been adapted from Dutch. The people of the northern province of Friesland speak Frisian, another Germanic language. Most Netherlanders also speak English or German, and many of them speak several foreign languages.

Education. Dutch law requires children from the age of 6 to 16 to go to school. All schools, including religious schools, that meet national educational standards receive government funds. These standards, which are set by law, include courses of study and the hiring of teachers.

The Netherlands has no general secondary school programme. Instead, it has several kinds of secondary schools. Each kind trains students for a special purpose, such as university work, advanced study in various institutes, or jobs in business or industry.

All the universities are supported almost completely by the government. Tuition fees are low, and many university students receive some form of government aid. The University of Amsterdam, with about 25,000 students, is the largest university. The State University of Leiden, founded in 1575, is the oldest.

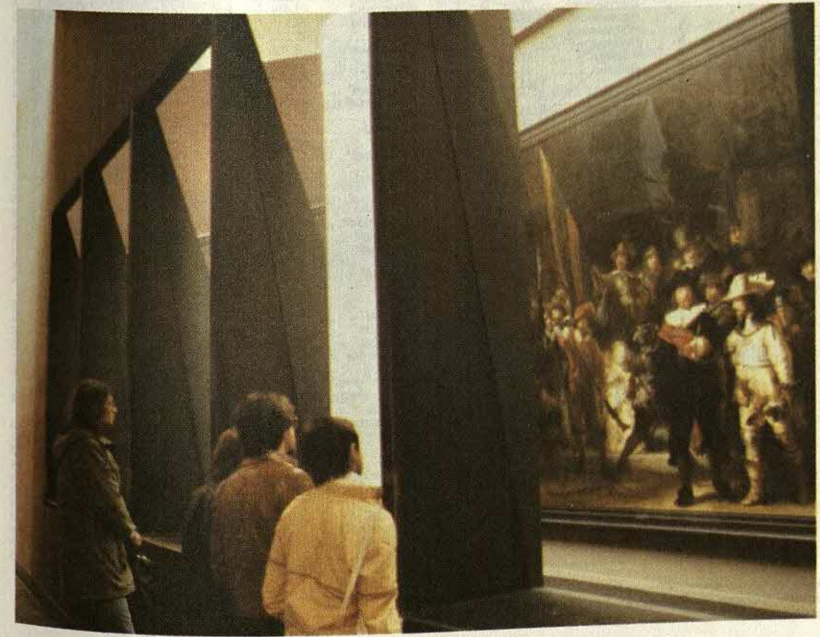
Arts. The Netherlands has produced some of the world's greatest painters. During the 1600's, the country's Golden Age, masterpieces were painted by Pieter de Hooch, Frans Hals, Rembrandt, Jacob van Ruisdael, and Jan Vermeer. At that time, most European artists painted only for churches, nobles, or royalty. But Dutch artists painted ordinary people and things, and many Dutch businessmen bought these works to beautify their homes. Later Dutch painters included Vincent van Gogh and Piet Mondrian. See **Painting** (The Renaissance in Flanders; The 1600's and 1700's; pictures).

The Dutch enjoy reading and support many writers. But Dutch literature is little known outside the Netherlands and few works have been translated. The most important Dutch writer was Joost van den Vondel. Others include Willem Bilderdijk, Louis Couperus, Constantijn Huygens, and "Multatuli" (Eduard Douwes Dekker).

The Netherlands has produced few noted composers. Among the better-known ones were Willem Pijper and Jan Pieterszoon Sweelinck. Several Dutch cities have fine symphony orchestras. The Concertgebouw Orchestra of Amsterdam is world famous.

Street performers entertain a crowd in Amsterdam. Busy Amsterdam is the capital and largest city of the Netherlands, and it is an important commercial centre of Europe.

A flower market in Amsterdam offers a variety of blooms. Flowers and flower bulbs are important products of the Netherlands. They are exported to countries throughout the world.



Masterpieces of Dutch art attract visitors to the Rijksmuseum in Amsterdam. The Netherlands has produced some of the world's greatest painters, including the old masters Rembrandt, Jan Vermeer, and Frans Hals, and the great modern artists Vincent van Gogh and Piet Mondrian.

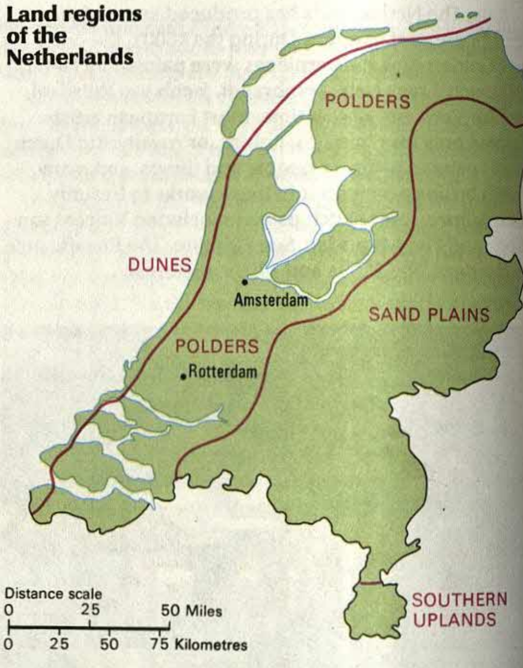
Land regions. The Netherlands has four main land regions: (1) the Dunes, (2) the Polders, (3) the Sand Plains, and (4) the Southern Uplands.

The Dunes rise 4.5 to 7.5 metres above sea level. This region curves in a line along the entire North Sea coast of the Netherlands. In the north, the line consists of the West Frisian Islands. The line is unbroken in the centre, but is broken in the south by wide river outlets. The sandy Dunes region cannot support farming, and few trees grow there.

The Polders lie mostly below sea level, and are protected from the sea by the sand dunes or by dikes. The Prins Alexander Polder, the lowest point in the Netherlands, lies about 6 metres below sea level. The Polders region forms over two-fifths of the country. It consists of flat, fertile areas of clay soils once covered by the sea, or by swamps or lakes. It has the country's most productive farmlands and largest cities.

The Sand Plains lie less than 30 metres above sea level in most places. In the southwest, the region rises higher. Low, sandy ridges cross the plains and create a rolling landscape. The soil is naturally infertile, but fertilizers make farming possible. Pine forests cover much of the region. A broad valley of clay soils marks the courses of the Maas (or Meuse) River and of

Land regions of the Netherlands



Netherlands map index

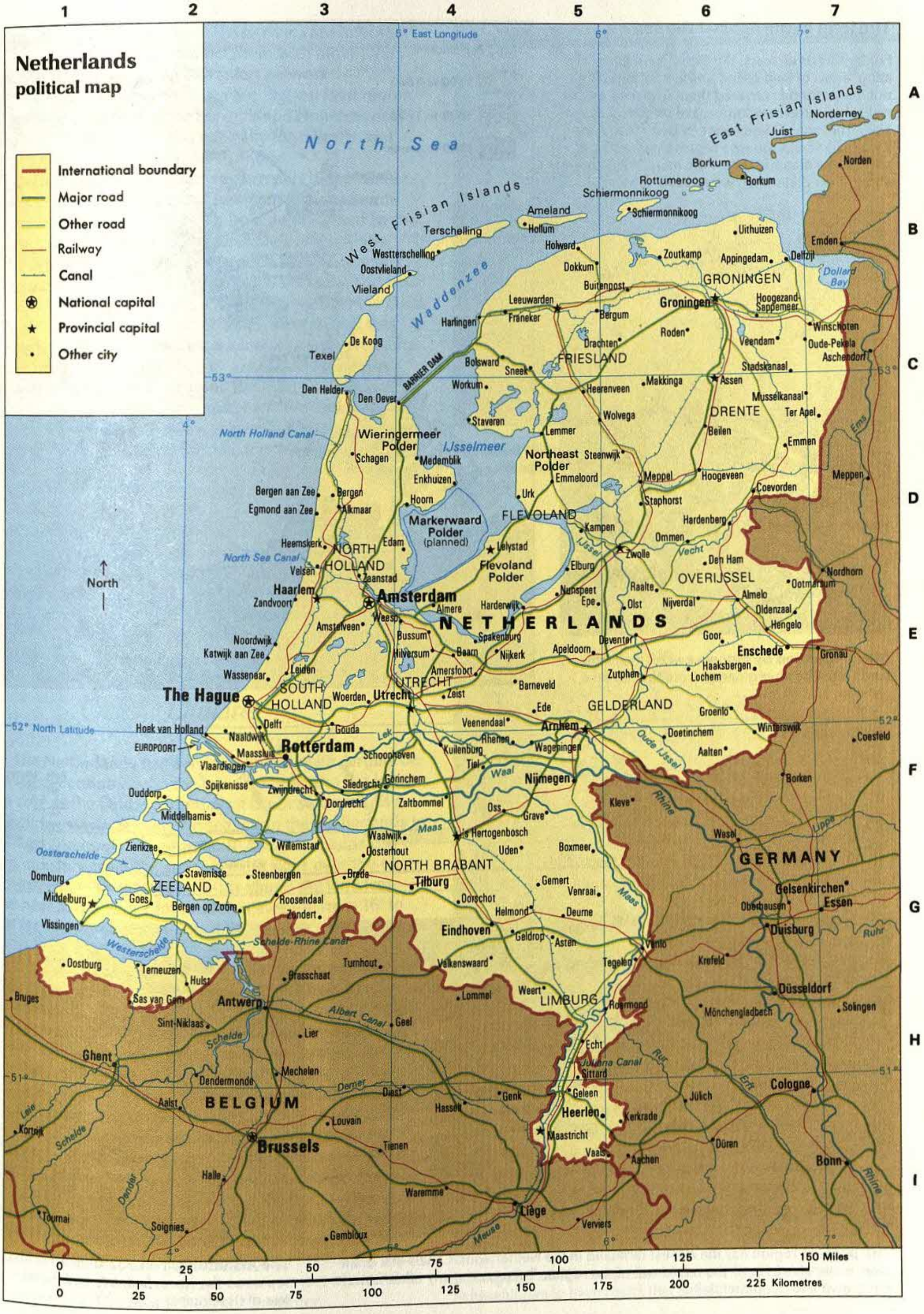
Provinces

Drente	424,720	C	6
Flevoland	180,000	D	4
Friesland	595,248	C	5
Gelderland	1,727,487	F	5
Groningen	560,708	B	6
Limburg	1,080,516	H	5
North Brabant	2,093,969	G	4
North Holland	2,308,047	D	3
Overijssel	1,000,572	E	6
South Holland	3,129,913	E	3
Utrecht	923,182	E	4
Zeeland	354,863	G	2

Cities and towns †

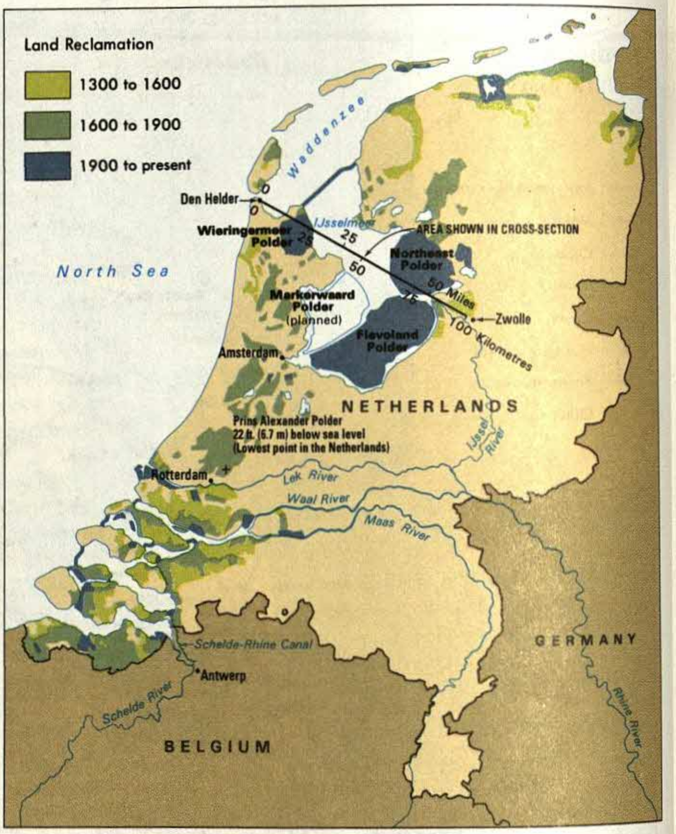
Aalten	17,875	F	6
Achtkarspelen*	26,989	C	5
Alkmaar	80,992	D	3
Almelo	63,080	E	6
Alphen aan den Rijn*	53,561	E	2
Amersfoort	87,461	E	4
Amstelveen	68,894	E	3
Amsterdam	687,397 *945,062	E	3
Apeldoorn	143,178	E	5
Appingedam	12,784	B	7
Arnhem	128,598 *290,506	F	5
Assen	45,906	C	6
Asten	14,230	G	5
Baarn	24,693	E	4
Barneveld	37,971	E	5
Beilen	13,480	C	6
Bergen	14,292	D	3
Bergen op Zoom	45,178	G	2
Best*	19,005	G	4
Beverwijk*	35,238	D	3
Boxtel*	24,553	G	4
Bolsward	9,843	C	4
Boxmeer	14,056	G	5
Breda	118,819 *152,449	G	3
Brunssum*	29,735	I	5
Bussum	33,941	E	4
Capelle aan den Ijssel*	51,401	F	3
Castricum*	22,625	E	3
Coevorden	13,957	D	6
De Bilt*	31,976	E	4
Delft	86,278	F	3
Delfziil	25,055	B	7
Den Ham	14,320	D	6
Den Helder	63,660	C	3
Deurne	28,352	G	5
Deventer	64,455	E	5
Doetinchem	38,585	F	6
Dokkum	12,288	B	5
Domburg	3,948	G	1
Dongen*	20,450	G	4
Dordrecht	107,612 *197,543	F	3
Drachten	50,402	C	5
Echt	16,973	H	5
Edam	23,853	D	4
Ede	85,894	F	5
Egmond aan Zee	10,779	D	3
Eindhoven	194,552 *373,233	G	4
Elburg	19,812	E	5
Emmen	90,828	D	7
Enkhuizen	15,631	D	4
Enschede	144,897 *247,266	E	7
Epe	33,386	E	5
Ermelo*	24,576	E	5
Etten*	30,174	G	3
Franeker	12,804	C	4
Geldrop	26,660	G	4
Geleen	35,319 *178,011	H	5
Gemert	16,666	G	5
Gilze en Rijen*	21,171	G	4
Goes	30,852	G	2
Goor	11,843	E	6
Gorinchem	28,021	F	4
Gouda	59,179	F	3
Grave	10,286	F	5
Groenlo	8,757	F	6
Groningen	166,942 *204,010	C	6
Haaksbergen	21,992	E	6
Haarlem	154,347 *221,551	E	3
Haarlemmermeer*	82,261	E	3
Hague, The ('s Gravenhage)	449,338 *677,962	E	2
Hardenberg	31,677	D	6
Harderwijk	32,284	E	5
Harlingen	15,752	C	4
Heemskerk	31,753	D	3
Heemstede*	25,785	E	3
Heerenveen	37,390	C	5
Heerhugowaard*	33,932	D	3
Heerlen	92,162 *264,107	I	5
Hellendoorn*	33,363	E	6
Helmond	59,354	G	5
Hengelo	76,532	E	6
Hilversum	89,518 *108,227	E	4
Hoogeveen	47,774	D	6
Hoogezand-Sappemeer	35,253	C	6
Hoorn	46,824	D	4
Huizen*	33,614	E	4
Hulst	18,639	G	2
Kampen	31,581	D	5
Katwijk aan Zee	38,604	E	3
Kerkrade	53,353	I	5
Krimpen aan den Ijssel*	28,142	D	3
Leeuwarden	85,055	C	5
Leiden	103,819 *174,501	E	3
Leidschendam*	30,239	E	3
Lelystad	52,251	D	4
Lemmer	11,016	D	5
Lochem	17,925	E	6
Maarssen*	32,225	E	4
Maassluis	33,291	F	2
Maastricht	112,605 *155,312	I	5
Meerssen*	20,275	H	5
Meppel	22,606	D	5
Middelburg	38,709	G	1
Middelharnis	14,888	F	2
Naaldwijk	25,869	F	2
Nieuwegein*	52,282	E	4
Nijkerk	24,101	E	4
Nijmegen	147,139 *227,840	F	5
Noordoostpolder*	37,885	D	5
Noordwijk	24,034	E	3
Nunspeet	22,917	E	5
Oldenzaal	28,747	E	7
Olst	9,048	E	5
Ommen	17,488	D	6
Oostburg	18,483	G	1
Oosterhout	45,446	G	3
Opsterland*	26,145	C	5
Oss	49,392	F	4
Oude-Pekela	8,208	C	7
Papendrecht*	25,665	G	3
Poortugaal*	22,271	F	3
Purmerend*	41,711	D	3
Raalte	25,311	E	6
Renkum*	33,828	F	5
Rheden	48,506	F	4
Ridderkerk*	47,108	F	3
Rijssen*	22,305	E	6
Rijswijk*	50,514	E	2
Roden	17,111	C	6
Roermond	38,126	H	5
Roosendaal	55,968	G	3
Rosmalen*	23,894	G	4
Rotterdam	558,832 *1,025,580	F	3
Rucphen*	20,095	G	4
Sas van Gent	9,286	H	2
Schagen	16,999	D	3
Schiedam*	71,280	F	2
Schijndel*	20,148	G	4
Schiermonnikoog	904	B	5
Schoonhoven	10,541	F	3
's Gravenhage, see Hague, The			
's Hertogenbosch	89,470 *186,627	F	4
Sittard	43,764	H	5
Sliedrecht	22,886	F	3
Sneek	28,545	C	5
Soest*	40,463	E	4
Spijkenisse	51,437	F	2
Stadskanaal	34,262	C	7
Staphorst	12,972	D	5
Staveren	957	C	4
Stein*	26,379	H	5
Steenbergen	13,681	G	2
Steenwijk	21,149	D	5
Tegelen	18,096	G	5
Terneuzen	35,440	G	2
Tiel	29,742	F	4
Tietjerksteradeel*	29,677	C	5
Tilburg	153,893 *220,511	G	4
Uden	33,500	G	5
Ulthoorn*	22,084	D	3
Urk	10,960	D	5
Utrecht	231,769 *494,898	E	4
Vaals	10,589	I	5
Valkenswaard	27,936	G	4
Veendam	28,486	C	7
Veenendaal	43,320	F	4
Veghel*	25,107	G	4
Veldhoven*	35,190	G	4
Velsen	59,118 *127,230	D	3
Venlo	62,567	G	6
Venraai	33,833	G	5
Vlaardingen	77,072	F	2
Vlissingen	46,382	G	1
Voorburg*	42,577	E	2
Voorst*	23,190	E	5
Vught*	23,133	G	4
Waalwijk	28,961	F	4
Wageningen	31,638	F	5
Wassenaar	27,025	E	3
Weert	39,293	H	5
Weesp	17,810	E	4
Weststellingwerf*	24,391	C	5
Wierden*	21,570	E	6
Wijchen*	25,895	F	5
Willemstad	3,300	F	3
Winschoten	20,795	C	7
Winterswijk	27,674	F	6
Woerden	25,060	E	3
Workum	4,522	C	4
Zaanstad	129,341 *141,991	E	3
Zaltbommel	8,955	F	4
Zandvoort	16,068	E	3
Zeist	61,329	E	4
Zevenaar*	26,812	F	6
Zierikzee	9,657	G	2
Zoetermeer*	74,853	E	3
Zundert	13,003	G	3
Zutphen	31,495	E	6
Zwijndrecht	39,795	F	3
Zwolle	86,388	D	5

*Does not appear on map; key shows general location.
†Populations are for municipalities that may include some rural areas as well as the city or town.
*Population of metropolitan area, including suburbs.
Source: 1983 official estimates.

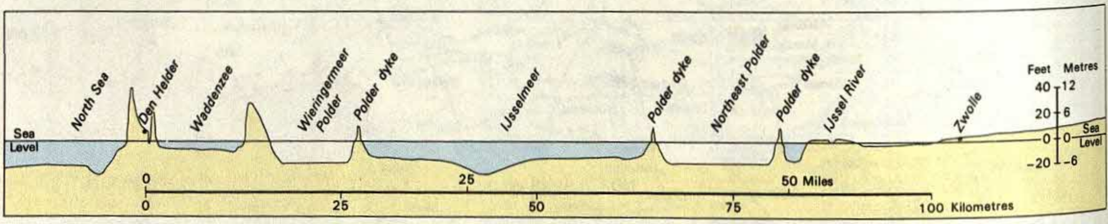

Netherlands
political map
International boundary
Major road
Other road
Railway
Canal
National capital
Provincial capital
Other city
1
2
3
4
5
6
7
A
B
C
D
E
F
G
H
I
5° East Longitude
6°
7°
53°
52° North Latitude
51°
4°
North
North Sea
East Frisian Islands
Norderney
Juist
Borkum
Norden
Rottumeroog
Schiermonnikoog
West Frisian Islands
Ameland
Hollum
Terschelling
Westterschelling
Oostvlieland
Vlieland
Waddenzee
Texel
De Koog
Den Helder
Den Oever
BARRIER DAM
Harlingen
Franeker
Leeuwarden
Holwerd
Dokkum
Buitenpost
Bergum
Drachten
Zoutkamp
Appingedam
Delfzijl
Emden
Uithuizen
Dollard Bay
GRONINGEN
Groningen
Hoogezand-Sappemeer
Winschoten
Roden
Veendam
Oude-Pekela
Aschendorf
Stadskanaal
FRIESLAND
Bolsward
Sneek
Workum
Makkinga
Heerenveen
Assen
Musselkanaal
Ter Apel
DRENTE
Staveren
Wolvega
Lemmer
Beilen
Emmen
Ems
Meppen
North Holland Canal
Wieringermeer Polder
IJsselmeer
Schagen
Medemblik
Enkhuizen
Northeast Polder
Steenwijk
Emmeloord
Meppel
Hoogeveen
Coevorden
Bergen aan Zee
Bergen
Egmond aan Zee
Alkmaar
Hoorn
Urk
Staphorst
Markerwaard Polder (planned)
FLEVOLAND
Kampen
Hardenberg
Heemskerk
NORTH HOLLAND
Edam
Lelystad
IJssel
Zwolle
Ommen
Vecht
Den Ham
Nordhorn
North Sea Canal
Velsen
Zaanstad
Flevoland Polder
Elburg
OVERIJSSEL
Ootmarsum
Haarlem
Zandvoort
Amsterdam
Almere
Harderwijk
Nunspeet
Epe
Raalte
Olst
Nijverdal
Almelo
Oldenzaal
Hengelo
Weesp
NETHERLANDS
Amstelveen
Bussum
Spakenburg
Noordwijk
Katwijk aan Zee
Hilversum
Baarn
Nijkerk
Apeldoorn
Deventer
Goor
Enschede
Gronau
Leiden
Wassenaar
Amersfoort
UTRECHT
Haaksbergen
Lochem
Zutphen
Barneveld
SOUTH HOLLAND
Zeist
The Hague
Woerden
Utrecht
Ede
GELDERLAND
Groenlo
Hoek van Holland
Delft
Gouda
Veenendaal
Arnhem
Winterswijk
Coesfeld
EUROPOORT
Naaldwijk
Maassluis
Rotterdam
Lek
Rhenen
Wageningen
Doetinchem
Oude IJssel
Aalten
Vlaardingen
Schoonhoven
Kuilenburg
Tiel
Waal
Spijkenisse
Sliedrecht
Gorinchem
Nijmegen
Borken
Ouddorp
Zwijndrecht
Dordrecht
Zaltbommel
Kleve
Rhine
Middelharnis
Oss
Grave
Wesel
Lippe
Maas
Waalwijk
's Hertogenbosch
Oosterschelde
Zierikzee
Willemstad
Oosterhout
Uden
Boxmeer
GERMANY
NORTH BRABANT
Domburg
Stavenisse
Steenbergen
Breda
Tilburg
Gemert
Gelsenkirchen
ZEELAND
Venraai
Essen
Middelburg
Goes
Bergen op Zoom
Roosendaal
Oirschot
Oberhausen
Zundert
Helmond
Deurne
Vlissingen
Eindhoven
Duisburg
Ruhr
Geldrop
Asten
Westerschelde
Schelde-Rhine Canal
Venlo
Oostburg
Terneuzen
Turnhout
Valkenswaard
Tegelen
Krefeld
Hulst
Brasschaat
Bruges
Sas van Gent
Antwerp
Lommel
Weert
LIMBURG
Roermond
Düsseldorf
Albert Canal
Geel
Mönchengladbach
Solingen
Sint-Niklaas
Schelde
Lier
Echt
Ghent
Juliana Canal
Rur
Mechelen
Sittard
Erft
Dendermonde
Demer
Diest
Genk
Geleen
Jülich
Cologne
Leie
Aalst
BELGIUM
Hasselt
Heerlen
Kerkrade
Kortrijk
Louvain
Maastricht
Schelde
Brussels
Tienen
Vaals
Aachen
Düren
Bonn
Halle
Dender
Waremme
Rhine
Tournai
Liège
Verviers
Soignies
Gembloux
Meuse
0
25
50
75
100
125
150 Miles
0
25
50
75
100
125
150
175
200
225 Kilometres

The long battle against the sea

For hundreds of years, the Dutch have been "creating" areas of land called *polders* by pumping out the water that covered them. The map on the right shows the development of polders since 1300. The straight line between Den Helder and Zwolle indicates the area represented horizontally on the diagram below the map. The diagram shows how dikes keep water from polders.



Dikes pounded by heavy seas off the Netherlands must be strengthened from time to time.



The polders region has the richest farmland in the Netherlands. Canals that drain away water also irrigate the fertile soil of the region. Tulips and many other flowers are grown there commercially.

The Afsluitdijk, a dike 32 kilometres long, separates the North Sea, *left,* and the waters of IJsselmeer.

branches of the Rhine River. These rivers are important waterways, and canals connect them with other rivers and canals to form a transportation network.

The Southern Uplands form the highest land region. The highest point, Vaalser Berg, rises 321 metres near Maastricht. The region has naturally fertile soils, and much fruit is grown in orchards there.

Delta. Much of the southwestern part of the Netherlands consists of islands and peninsulas in the North Sea. These marshy areas make up a delta formed by the Maas and Schelde rivers and branches of the Rhine River. In 1953, a storm broke through the dikes in this region. The sea flooded over 151,800 hectares, and over 1,800 people drowned. In 1958, work began on the Delta Project to prevent a similar disaster. This project was completed in 1986. It includes a series of massive dams, which connect the islands and prevent the sea from flooding the region. Enormous floodgates allow salt water and natural tides to enter the protected area. This preserves the natural environment and the fishing economy of the delta. During storms, the floodgates can be closed.

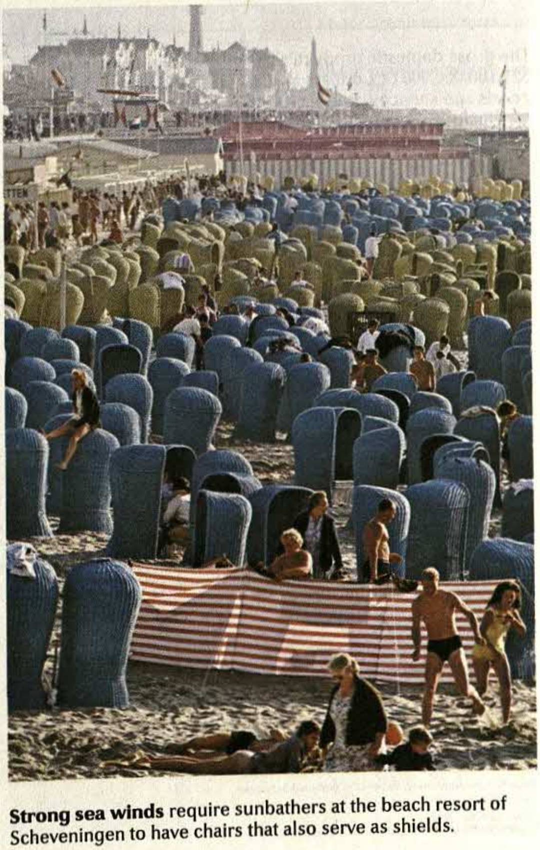
Climate

The Netherlands has a mild, damp climate, largely because the country is on the sea. In winter, the sea is not so cold as the land. In summer, it is not so warm. As a result, west winds from the sea warm the Netherlands in winter, and cool it in summer. In addition, winds carrying moisture from the sea make the skies over the country extremely cloudy. The clouds shield the land from the heat of the sun. Temperatures average from 16° to 18° C in summer, and rise to a little above −1° C in winter.

The country has no mountains to block the winds, so there are no great differences of climate from area to area. The extreme southeast, which is the highest part of the Netherlands, is also the wettest. It receives a yearly average of more than 86 centimetres of *precipitation* (rain, melted snow, and other forms of moisture). An average of 69 centimetres a year falls on the islands of Zeeland province and along the central Dutch-German border. Summer is the wettest season, but precipitation is fairly evenly distributed throughout the year. Brief showers, however, may fall as often as every 30 minutes in some regions.

North Sea storms are heaviest in the coastal areas of the Netherlands. These storms have broken dikes and caused flooding, sometimes with great loss of life. The northern and western regions receive most of the mist from the sea. The mist is heaviest in winter.

The Sand Plains of the Netherlands are a low, mostly flat region with some ridges. Dairy cattle graze in pastures there.



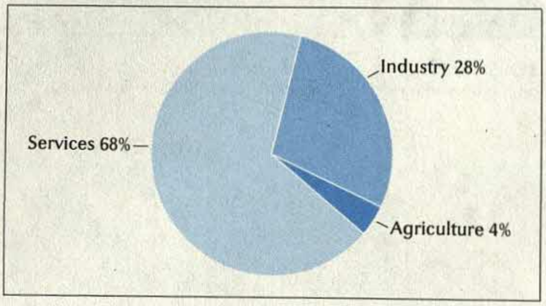
Strong sea winds require sunbathers at the beach resort of Scheveningen to have chairs that also serve as shields.

Economy

The Netherlands' economy is technically advanced and highly industrialized. Skilled workers have made possible manufacturing industries such as electronics and chemicals. Modern farming techniques have made the Netherlands' small amount of farmland highly productive. Because the country is small and has few natural resources, it depends heavily on foreign trade. Dutch industries import most raw materials, and export finished products. Shipping, banking and other financial services, and tourism are also important to the Dutch economy.

The importance of foreign trade to the Netherlands makes the country a strong supporter of international economic cooperation. In the 1950's, the Netherlands helped form several economic groups that became the basis of the European Community (EC), an economic association of European nations. The EC has done much to expand Dutch trade and improve the economy. In 1993, the EC countries formed the European Union, which works for both economic and political cooperation among its members. See **European Union.**

Gross domestic product of the Netherlands



The gross domestic product (GDP) of the Netherlands was 321,100,000,000 U.S. dollars in 1992. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, social, and personal services; finance, insurance, property, and business services; government; trade, restaurants, hotels, and repair shops; transportation and communication; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Production and workers by economic activities

Economic activities	Per cent of GDP produced	Employed workers: Number of people	Employed workers: Per cent of total
Finance, insurance, property, & business services	24	655,000	11
Manufacturing	19	1,104,000	19
Trade, restaurants, hotels, & repair shops	15	1,044,000	18
Government	11	*	*
Community, social, & personal services	9	1,955,000	33
Transportation & communication	7	377,000	7
Construction	6	377,000	7
Agriculture, forestry, & fishing	4	237,000	4
Utilities	2	45,000	1
Mining	1	9,000	†
Total	100	5,803,000	100

*Included in Community, social, and personal services.
†Less than one-half of 1 per cent.
Figures are for 1992.
Source: Netherlands Central Bureau of Statistics.

Natural resources. The Netherlands has large deposits of salt and natural gas. It also has some deposits of petroleum. The Polders region has fertile soils. Forests—most of which are beech, oak, or pine—cover only about 8 per cent of the land. Many rivers flow through the Netherlands.

Service industries, taken together, account for about two-thirds of the Netherlands' *gross domestic product* (GDP—the total value of goods and services produced within a country in a year). About 70 per cent of all workers are employed by service industries. Finance, insurance, property, and business services provide about a quarter of the country's GDP—more than any other industry.

Trade, restaurants, hotels, and repair shops form the second most important type of service industry in the Netherlands. Amsterdam and Rotterdam are centres of wholesale and retail trade in Europe. Other service industries include community, social, and personal services; government; transportation and communication; and utilities.

Manufacturing accounts for about a fifth of the GDP of the Netherlands. The country must import most of the raw materials used by the manufacturing industries. The government and organizations of employers and workers have cooperated in establishing wages and other job policies. As a result, strikes are uncommon among the country's manufacturing industries.

A steelworks operates on the North Sea Canal, near Amsterdam. Shipyards are located in and around Rotterdam. Eindhoven is the headquarters of one of the world's largest electronics firms. The firm's factory there produces such items as household appliances, computers, and stereo system components. Other factories produce cars and trucks, small commercial aeroplanes, and industrial machinery.

Food processing is a major manufacturing industry. Dairy products are the chief food products. The Netherlands is one of the world's major cheese manufacturers. Other food products include beer, chocolate, processed meats, and sugar. The chemical industry produces drugs, fertilizers, paints, plastics, and synthetic rubber. There are several large oil refineries near Rotterdam. The textile industry produces goods of cotton, linen, wool, and synthetic fibres. Amsterdam has long been a famous centre of diamond cutting and polishing.

Agriculture. The Dutch cannot afford to waste any land because their country is so thickly populated. The farmers fertilize their land heavily and use modern machinery. Dutch farms cover an average of only 15 hectares. About two-thirds of the total land area is farmland. Almost 55 per cent of the farmland is used for grazing, and crops are grown on the rest.

Dairy farming is the most important branch of agriculture in the Netherlands. Most of the dairy farmers also grow crops, which are used mainly to feed the livestock. Almost 5½ million cattle—mainly dairy cattle—graze on the grasslands. Farmers also rear beef cattle, pigs, poultry, and sheep.

The most important crops, in order of acreage, are potatoes, sugar beet, wheat, and barley. An important speciality of Dutch agriculture is horticulture. Flowers and vegetables are grown in enormous greenhouses. They are exported to neighbouring countries, and fresh flowers are flown to most parts of the world. Flower bulbs, especially tulips, are also important. Daffodils, hyacinths, and tulips carpet the countryside between Haarlem and Leiden every April and May.

Mining. The Dutch produce much natural gas. One of the world's largest reserves of this fuel—the Slochteren field—lies in Groningen province in the northeastern part of the Netherlands. Oil wells operate in the northeastern province of Drente and near The Hague. They supply only a small part of the country's needs.

Beds of salt lie near Hengelo. Miners dissolve the raw salt underground and pump the *brine* (salt water) to the surface, where it is evaporated to get the salt.

Fishing. The Dutch fish catch comes mainly from coastal waters and inlets, and from the North Sea. Mussels, eels, and shrimp are caught in coastal waters. The major sea catches are herring, mackerel, and flatfish.

Transportation. The Netherlands has an extensive network of navigable rivers and canals. The main rivers and many of the canals are important waterways, and oceangoing ships use the larger ones. Motor barges on the inland waterways carry more than half the nation's total freight. The Netherlands has an excellent network of paved roads. Almost all Dutch families own a car. A government-owned railway system provides fast and frequent service.

Most of the Dutch have a bicycle. There are nearly as many bicycles as people in the country. Separate bike paths are found throughout the country. Motor-driven bicycles called *bromfietsen* are also common.

Rotterdam is the busiest seaport in the Netherlands and one of the busiest in the world. It serves as a gateway to and from much of Europe by way of the Rhine River, Europe's busiest inland waterway. Amsterdam, the second largest Dutch port, is linked to the North Sea by the North Sea Canal, one of the world's deepest and widest canals. The canal is about 15 metres deep and 160 metres wide.

The Dutch national airport, Schiphol, is near Amsterdam. It is one of the busiest airports in Europe. Royal Dutch Airlines (KLM) has headquarters there. Established in 1919, KLM is the oldest airline in the world still in operation.

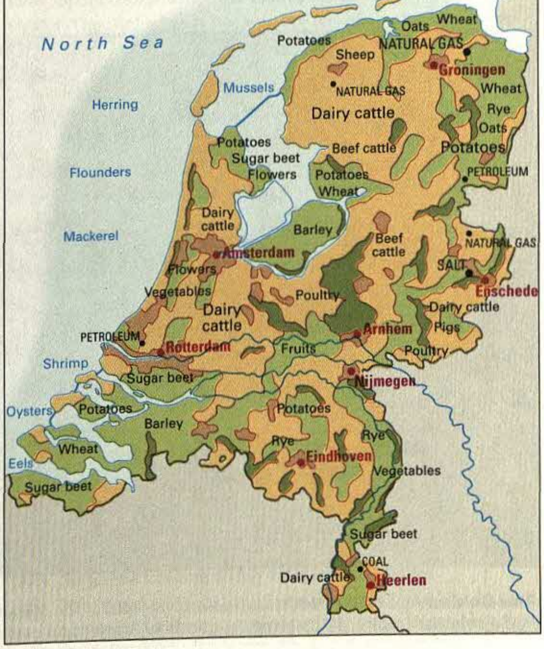
Communication. The Netherlands has about 80 daily newspapers. The largest is *De Telegraaf,* published in Amsterdam and sold throughout the country.

The government owns and regulates the nation's radio and television networks. But eight broadcasting companies prepare most programmes for the networks. Most of them represent political, religious, or cultural groups. Almost all Dutch families own one or more radios and television sets. The postal, telephone, and telegraph services are operated by the government.

The famous Alkmaar cheese market is held on Fridays from spring to autumn. Porters in colourful hats carry the cheeses.

Economy of the Netherlands

🟩 Mostly cropland
🟧 Mostly grazing land
🟩 Forest land
🟫 Major urban-industrial area
● Major manufacturing centre
• Mineral deposit



History

Early days. In 58 B.C., Roman soldiers under Julius Caesar invaded what are now the Netherlands, Belgium, and Luxembourg. The Romans conquered much of the region, now called the Low Countries. The word *Netherlands* means *Low Countries,* but the Low Countries also include Belgium and Luxembourg.

During the A.D. 400's, Germanic people called Franks drove the Romans out of the Low Countries. The Frankish kingdom expanded, but broke apart during the 800's. In 870, the Low Countries were divided between the East and West Frankish kingdoms (later Germany and France). The northern part, including what is now the Netherlands, became part of the East Frankish kingdom.

The rise of commerce. At first, the French and German rulers of the Low Countries paid little attention to the region. Local dukes, counts, and bishops became increasingly powerful. But during the 1100's, trade and industry began to expand rapidly in the Low Countries. Fishing, shipbuilding, shipping, and textile manufacturing became especially important. The French and German kings became interested in the Low Countries after the thriving trade developed. The towns, which wanted to stay free, supported the local nobles in struggles against the foreign rulers.

Unification. Beginning in the 1300's, the French dukes of Burgundy won control of most of the Low Countries through inheritance, marriage, purchase, and war. They promoted central government, and political and national unity began to develop.

In 1506, Charles V inherited the lands of the dukes of Burgundy. In 1516, he also became king of Spain. In this way, the Low Countries came under Spanish control. Charles became archduke of Austria and emperor of the Holy Roman Empire in 1519. Beginning in 1520, Charles further strengthened the central government of the Low Countries.

Freedom from Spain. During the early 1500's, the Protestant movement called the Reformation spread through the Low Countries. Charles tried to stop this threat to Roman Catholicism by persecuting Protestants. His son, Philip II of Spain, inherited the Low Countries in 1555. Philip stepped up the struggle against Protestants, and tried to take complete power over the Low Countries. In 1568, the nobles there revolted against his harsh rule. They were led by William I (called the Silent), prince of Orange.

The Spanish troops were generally successful in land battles, but the rebels' ships controlled the sea. The Spaniards attacked Leiden in 1573, but the city held out bravely. In 1574, the people opened dikes that held back the sea, and a Dutch fleet sailed over the floodwaters to rescue Leiden from the Spaniards.

By 1579, the revolt had started to break apart. Roman Catholic nobles in the southern provinces of the Low Countries (now Belgium) had become dissatisfied and returned to Spanish control. Protestantism became stronger in the northern provinces (now the Netherlands). In 1579, most of the northern provinces formed the Union of Utrecht and pledged to continue the revolt against Spain.

On July 26, 1581, the northern provinces declared their independence from Spain, beginning what later became known as the Dutch Republic or the Netherlands. The Dutch fought for their freedom until 1648, except for a temporary peace from 1609 to 1621. Spain finally recognized Dutch independence in 1648.

Prosperity and power. The 1600's were the Golden Age of the Netherlands. The country became the leading sea power. Its merchant fleet tripled in size between 1600 and 1650, and Dutch ships supplied about half the world's shipping. Dutch explorers, including Willem Barents and Abel Janszoon Tasman, found new sea

The Golden Age of the Netherlands was the 1600's. The nation was the leading sea power and had a colonial empire. Ships bringing goods to Amsterdam made it the world trade centre.

routes and fishing grounds. Expanding trade made Amsterdam the world's major commercial city, and gave the Dutch the highest standard of living. There were also major cultural achievements, especially in painting.

During the Golden Age, the Dutch developed a great colonial empire in many parts of the world. In 1602, Dutch firms trading with the East Indies combined to form the Dutch East India Company. The company founded Batavia (now Jakarta, the capital of Indonesia) as its headquarters. The company's forces drove the British and Portuguese out of what later became the Netherlands Indies (now Indonesia). The company also took control of Ceylon (now Sri Lanka) and colonized the southern tip of Africa. From the mid-1600's to the mid-1800's, the Dutch were the only Westerners allowed to trade with Japan.

The Dutch West India Company was founded in 1621 to trade in the New World and western Africa. In 1624, the company colonized New Netherland, which consisted of parts of present-day New York, New Jersey, Connecticut, and Delaware in the United States. In 1626, Dutch colonists bought Manhattan Island from the Indians for goods worth about 24 U.S. dollars. They had established New Amsterdam (now New York City) there in 1625. In 1634, the Dutch captured what are now the Netherlands Antilles and Aruba from the Spaniards.

Wars with England and France. The Netherlands fought three naval wars with England between 1652 and 1674. The English hoped to seize the shipping and trading leadership from the Dutch, but failed. During this period, the Dutch won what is now Suriname from the English, and the English gained New Netherland.

France and England formed a secret alliance against the Dutch Republic in 1670, and attacked it in 1672. The Dutch fleet prevented the English from landing by sea, but French troops seized a number of Dutch towns. William III, prince of Orange, was then elected *stadholder* (governor). He stopped the French by opening some dikes and flooding the land. Spanish and German troops also helped the Dutch. The English suffered major defeats at sea, and made peace with the Dutch in 1674. The French were driven out, and signed a peace treaty in 1678. William's wife, Mary, was a member of the English royal family. In 1689, he became King William III of England as well as the Dutch stadholder. The Netherlands, England, and other European countries defeated France in two more wars, fought from 1689 to 1697 and from 1701 to 1714.

The 1700's. The long wars against France exhausted the Netherlands. In the war that ended in 1714, the Netherlands lost leadership of the seas to Great Britain. Dutch industry and trade stopped expanding.

When the American Revolution (1775-1783) began, the Dutch aided the Americans against the British. Britain started a naval war against the Dutch in 1780. The Dutch were severely defeated by 1784.

In 1795, the weakened Netherlands fell to invading French troops. The French renamed the country the Batavian Republic, and set up a new government. Britain seized most of the Dutch overseas possessions.

Independence. In 1806, Napoleon I of France forced the Dutch to accept his brother, Louis, as their king. The Batavian Republic became the Kingdom of Holland. Napoleon wanted tighter control over the country, and made it a part of France in 1810. The Dutch drove out the French in 1813.

After Napoleon's final defeat in 1815, Europe's political leaders remapped much of the continent at the Congress of Vienna. They united Holland, Belgium, and Luxembourg into the Kingdom of the Netherlands to strengthen barriers against expansion by France. William VI, prince of Orange, became King William I of the Netherlands and Grand Duke of Luxembourg. In 1830, Belgium declared its independence. Luxembourg ended its political ties with the Dutch royal family in 1890.

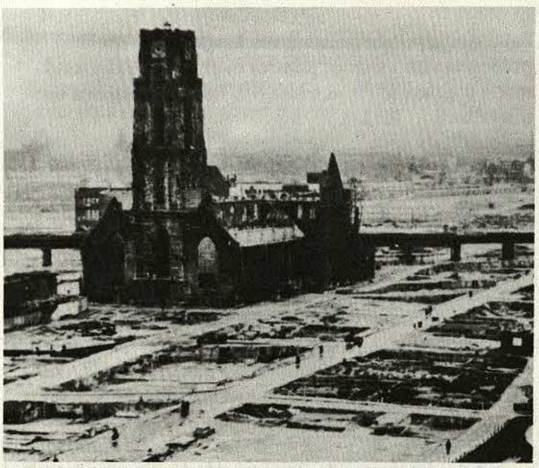
The Netherlands stayed neutral during World War I (1914-1918). British and German naval operations hindered Dutch fishing, shipping, and trading.

World War II. On May 10, 1940, German troops invaded the Netherlands. Four days later, German bombers destroyed much of Rotterdam. The Dutch army surrendered. Most of the Dutch navy and merchant fleet escaped capture and supported the Allies.

The Dutch suffered greatly during the German occupation. The Germans killed about 75 per cent of the na-

Important dates in the Netherlands

58 B.C.	Julius Caesar conquered much of the Low Countries, including what is now the Netherlands.
A.D. 400's-800's	The Franks controlled the region.
870	The Netherlands became part of the East Frankish kingdom (now Germany).
1300's-1400's	The French dukes of Burgundy united most of the Low Countries.
1516	Charles V, ruler of the Low Countries, also became king of Spain.
1581	The Dutch declared their independence from Spain.
1648	Spain recognized Dutch independence.
1600's	The Netherlands became the world's major sea power and developed a great colonial empire.
1652-1674	The Netherlands fought three naval wars with England, and kept leadership of the seas.
1701-1714	The Dutch lost control of the seas to England during a war against France.
1795-1813	France controlled the Netherlands.
1815	The Netherlands became an independent kingdom united with Belgium.
1830	Belgium revolted and became independent.
1914-1918	The Netherlands remained neutral during World War I.
1940-1945	Germany occupied the Netherlands during World War II. Queen Wilhelmina headed the Dutch government-in-exile in London.
1949	The Netherlands granted independence to the Netherlands Indies (now Indonesia).
1954	The colonies of Suriname and Netherlands Antilles became equal partners in the Dutch kingdom.
1957	The Netherlands helped form the European Common Market (now known as the European Union).
1962	The Netherlands gave up control of Netherlands New Guinea (now Irian Jaya) to the United Nations.
1975	Suriname became a fully independent nation.
1986	The island of Aruba separated from the Netherlands Antilles and became an equal partner in the Dutch kingdom.



Hit by German bombers during World War II, the centre of Rotterdam was destroyed. The city was rebuilt after the war.

tion's Jews—about 104,000 people—mostly in death camps. They also forced thousands of other Netherlanders to work in German factories. Secret Dutch groups fought the Germans, organized strikes, and aided escaped prisoners and Allied fliers who had been shot down. In March 1942, the Netherlands Indies (Indonesia) fell to Japan, an ally of Germany. By the time Germany surrendered to the Allies in May 1945, about 270,000 Netherlanders had been killed or starved to death. See **World War II.**

Economic recovery. World War II left much of the Netherlands in ruins. The destruction included almost half the nation's factories and shipping, and most of its railways. The great harbours at Amsterdam and Rotterdam were crippled. About a seventh of the land was flooded as a result of war damage to the dykes.

After the war, the Dutch dedicated themselves to rebuilding their country. In 1945, the Netherlands became a charter member of the United Nations. In 1947, it joined the European nations working together for recovery under the Marshall Plan of the United States. The Netherlands received 1 billion U.S. dollars in Marshall Plan aid. The Dutch also joined other campaigns to promote international unity, including Benelux, the Council of Europe, the European Coal and Steel Community, the European Common Market (now the European Union) and the North Atlantic Treaty Organization.

By 1955, Dutch industrial production had increased about 60 per cent over the pre-World War II level. Farm output was almost 20 per cent greater.

Political changes. In 1945, a revolt began in the Netherlands Indies. The fighting continued until 1949, when the Netherlands recognized the independence of Indonesia. See **Indonesia** (History).

Suriname and the Netherlands Antilles—which then included the island of Aruba—were made self-governing and equal members of the Dutch kingdom in 1954. In 1962, the Dutch gave up Netherlands New Guinea (now Irian Jaya), their last colony, to United Nations control. Indonesia had claimed the region, and fighting had broken out earlier that year. The United Nations gave control of Irian Jaya to Indonesia in 1963.

Recent developments. Today, the Netherlands has a high standard of living, largely because of its policy of economic cooperation. This cooperation has taken place not only with other countries, but also at home. After World War II, Dutch industry, trade unions, and the government worked together to keep wages and prices low. Their action encouraged the swift expansion of industries. The nation's political parties also cooperated to support the economic programme. By the mid-1960's, Dutch prosperity had been reestablished. Wage and price levels were then raised to those of other prosperous European countries.

Hundreds of thousands of people from former Dutch colonies and from Mediterranean countries have moved to the Netherlands. This immigration has added diversity to the country's population. Many of the immigrants came from Indonesia. Some of them, particularly people from the Molucca Islands, formed groups dedicated to freeing their homelands from Indonesian control. In the 1970's, Moluccans resident in the Netherlands demanded that the Dutch government free their homeland. Some staged terrorist acts to dramatize their demands.

In 1975, Suriname left the Dutch kingdom and became a fully independent nation. Many people from Suriname moved to the Netherlands shortly before independence. In 1986, Aruba separated from the Netherlands Antilles and became an equal member of the Dutch kingdom.

Related articles in ***World Book*** include:

Biographies

Arminius, Jacobus
Barents, Willem
Beatrix
Bosch, Hieronymus
De Hooch, Pieter
DeJong, Meindert
De Sitter, Willem
De Vries, Hugo
Dubois, Eugène
Einthoven, Willem
Elzevir (Louis; Bonaventure)
Erasmus, Desiderius
Fokker, Anthony
Frank, Anne
Grotius, Hugo
Hals, Frans
Huizinga, Johan
Huygens, Christian
Juliana
Lasso, Orlando di
Leeuwenhoek, Anton van
Lorentz, Hendrik
Mata Hari
Minuit, Peter
Mondrian, Piet
Rembrandt
Ruisdael, Jacob van
Spinoza, Baruch
Stuyvesant, Peter
Swammerdam, Jan
Tasman, Abel J.
Thomas à Kempis
Van Gogh, Vincent
Van Leyden, Lucas
Van Rensselaer, Kiliaen
Vermeer, Jan
Wilhelmina
William (III)
William I
William I, Prince of Orange

Cities

Amsterdam
Breda
Hague, The
Leiden
Rotterdam
Utrecht

History

Belgium (History)
Dutch East India Company
Dutch West India Company
Indonesia (History)
Luxembourg (History)
New Guinea
New Netherland
United Nations (The Indonesian dispute)
Vienna, Congress of

Physical features

Low Countries
Meuse River
North Sea
Rhine River
Schelde River

Treaties and agreements

Benelux
Europe, Council of
European Union
North Atlantic Treaty Organization
Western European Union

Other related articles

Christmas (In the Netherlands, Belgium, and Luxembourg)
Delft (pottery)
Europe (pictures)

Flower (picture: Tulip farms)
Gas (fuel)
Hyacinth
Netherlands Antilles
Nicholas, Saint
Suriname
Tulip
Windmill

Outline

- **I. Government**
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  - A. Land regions
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- **VI. History**

Questions

How do the Netherlanders "make" land?
What is the largest seaport in the Netherlands?
What parts of the Kingdom of the Netherlands are in the Western Hemisphere?
What is the *Elfstedentocht*?
What is the leading branch of Dutch agriculture?
How did the Dutch lose leadership of the seas to the English?
When was the Golden Age of the Netherlands?
What does the word *Netherlands* mean?
When did they officially win independence?
How did the Dutch come under Spanish control?
What is *gezelligheid*?

Netherlands Antilles, also called the Dutch Antilles or the Dutch West Indies, is part of the Kingdom of the Netherlands located in the Caribbean Sea. The territory consists of two groups of islands. One group lies about 80 kilometres from the coast of Venezuela. The other is about 800 kilometres northeast of the first group and about 255 kilometres east of Puerto Rico.

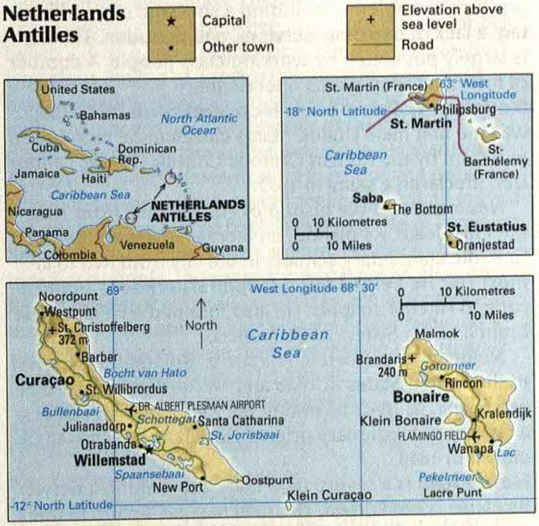
The islands have a total land area of 798 square kilometres and a population of 196,000. The southern group, made up of Bonaire and Curaçao, covers 730 square kilometres and has about nine-tenths of the population. Curaçao, which covers 444 square kilometres, is the largest island. Willemstad, capital of the Netherlands Antilles, is on Curaçao. The northern group includes Saba and Saint (or Sint) Eustatius islands, and the southern part of the large island of Saint Martin (or Sint Maarten in Dutch). The rest of this island is administered by France. See **Curaçao; Willemstad.**

People. The population of the Netherlands Antilles is of mixed origins. The population of Saint Martin is mostly descended from African slaves. On Saba, there is an even distribution between people of African and Dutch and English ancestry. People in the southern islands of Curaçao and Bonaire are of mixed African, Spanish, Dutch, and English descent. The people speak Dutch, English, Spanish, and *Papiamento* (a mixture of the three European languages together with Portuguese and African words).

Government. The Netherlands Antilles is an equal partner with the Netherlands in the Kingdom of the Netherlands. The islands are self-governing. The governor is appointed by the Dutch monarch.

Economy. Petroleum refining and tourism are the major industries in the Netherlands Antilles. Other major economic activities are ship-repairing, port services, and financial services for foreign companies. The other islands are of little economic importance. The land on Curaçao is so rocky that little farming is possible. Most food must be imported. There are international airports on Curaçao and Bonaire.

Netherlands Antilles



History. The Spanish first occupied Curaçao in 1527. The Dutch captured the Antilles area in 1634, and soon settled on the other islands. The island of Aruba was once part of the Netherlands Antilles (see **Aruba**).

Nettle is the common name of a group of plants with stinging bristles. Nettles are coarse herbs that grow in temperate regions. They have leaves that grow opposite one another on the stem, and tiny flower clusters.

Nettle bristles contain a watery juice that produces an intense itch when it enters a person's skin. This itch does not last long.

Young shoots of nettle plants can be cooked like spinach and are a good source of vitamins and protein. People have used nettles for medicinal purposes since ancient times. The *stinging nettle* of Europe and the United States has been cultivated for its fibre, from which a strong, coarse cloth can be made.

Stinging nettle

Scientific classification. Nettles belong to the nettle family, Urticaceae. They make up the genus *Urtica*. The stinging nettle is *U. dioica*.

See also **Boehmeria.**

Nettle tree. See **Hackberry.**

Netzahualcóyotl (pop. 1,256,115) is Mexico's third-largest city. Netzahualcóyotl lies in the state of México and borders Mexico City on the east. For location, see **Mexico** (political map). Netzahualcóyotl was founded in 1900 as a suburb of Mexico City. It was not incorporated as a city until 1963. Since 1970, Netzahualcóyotl's population has more than doubled. The city's rapid growth has produced problems, including a shortage of good housing, a lack of basic city services, and pollution. The city is largely populated by working-class people. A number of manufacturing plants operate there.

Neumann, Saint John Nepomucene (1811-1860), was the first male United States citizen to be recognized as a saint by the Roman Catholic Church. He was *canonized* (declared a saint) in 1977.

Neumann was the bishop of Philadelphia from 1852 until his death. As bishop, he increased the number of Catholic elementary schools in the city from two to almost 100. He helped bring several sisterhoods from Europe to run the schools. He also founded a Philadelphia branch of the Sisters of St. Francis.

Neumann was born in Prachatitz, Bohemia. He moved to the United States in 1836 and was ordained later that same year. In 1840, he joined the Redemptorist Fathers, a society of missionary priests. Neumann became a U.S. citizen in 1848.

Neuralgia is a severe pain that occurs along a nerve. Its cause is not known. The pain may be limited to one part of the nerve, or it may extend along the nerve's branches. It may occur as repeated stabs of pain in the teeth, sinuses, eyes, face, tongue, or throat.

Neuralgia occurs most frequently in two cranial nerves. One nerve, the *trigeminal,* has three branches that enter the eyes, face, sinuses, and teeth. The other, the *glossopharyngeal,* leads to the back of the tongue and throat.

Neuralgia is sometimes confused with other conditions called *neuritis* and *radiculopathy.* But these occur in many different parts of the body. True neuritis is an inflammation that can permanently damage a nerve. Neuralgia does not harm the nerve.

Tic douloureux is a type of neuralgia that is common among older people. The name is French for *painful twitching.* Tic douloureux affects the trigeminal nerve and causes facial pain. The face muscles may contract each time a stab of pain occurs. The pain occurs very suddenly and then shoots along one side of the face. It usually begins at a specific part of the nerve called the *trigger zone.* It may then spread along branches of the nerve, but it never involves other nerves. The pain may last a few hours or several weeks. It may then disappear for a few months or years, but it usually returns.

Glossopharyngeal neuralgia is a very rare condition. It affects the throat and the back of the tongue.

Both types of neuralgia may be relieved by using drugs, or by numbing the nerve with an injection of alcohol. If the pain does not disappear, the only cure is a surgical operation to remove part of the nerve.

See also **Neuritis.**

Neuritis is an inflammation of a nerve caused by disease or injury. It is a painful condition that may affect one or many nerves. It is sometimes confused with a disorder called neuralgia (see **Neuralgia**).

Bacteria, viruses, and diet and vitamin deficiencies can cause neuritis. Infections such as tuberculosis, syphilis, and *herpes zoster* (shingles) can invade a nerve, resulting in neuritis. Neuritis can also develop when a disease, such as diabetes, changes the activities of the body's cells. Neuritis caused by physical injury to a nerve involves only the injured nerve.

If neuritis continues for a long period of time, a nerve may become so badly damaged that it can no longer function properly. As a result, a person may lose the ability to sense heat, pressure, and touch. The body also may lose control over such automatic activities as sweating. If a nerve no longer can stimulate a muscle, the muscle wastes away and eventually becomes paralysed.

Neurofibromatosis, often abbreviated as *NF,* is an incurable hereditary disorder that affects the nervous system and the skin. It is sometimes called the *elephant man's disease* because of Joseph Merrick, an Englishman who was mistakenly thought to have a severe case of neurofibromatosis. Neurofibromatosis may range in severity from a mild disorder to a severely disfiguring one. There are two forms, *NF-1* and *NF-2.*

NF-1, also called *Von Recklinghausen's disease,* is more common and less severe. It occurs in about 1 out of every 4,000 births. The major signs are flat, light brown spots on the skin called *cafe-au-lait spots,* and *benign* (noncancerous) tumours of the nerves. The tumours, called *neurofibromas,* often develop just beneath the surface of the skin, producing small to large skin growths. Tumours may affect many other parts of the body, including the bones. Many people with NF-1 have *scoliosis* (curvature of the spine). In some cases, tumours affect vital organs, and NF-1 may be life-threatening. Cafe-au-lait spots are usually present at birth. Neurofibromas usually appear at puberty.

NF-2, also called *bilateral acoustic neurofibromatosis,* is much rarer than NF-1, occurring in about 1 out of every 50,000 births. NF-2 is characterized by tumours in the brain, on the spinal cord, and on the nerves that control hearing. The tumours may lead to deafness, chronic headache, vision problems, partial paralysis, and, eventually, death. The first signs of NF-2 usually appear in the teens or early twenties.

The child of a person with NF has a 50 per cent chance of inheriting the disorder. However, about half of all NF victims have no family history of the disorder. There is no treatment other than surgical removal of the tumours. However, hopes for finding a treatment were raised in 1990, when researchers identified the gene responsible for NF-1. This gene produces a protein, called *neurofibromin,* that researchers believe causes the disorder.

Neurology is the field of medicine concerned with the diagnosis and treatment of diseases of the nervous system and muscles. The nervous system consists of the brain, spinal cord, and nerves (see **Nervous system**). *Neurologists* are doctors who receive specialist training in neurology after completing medical school and in-work training. They evaluate and treat patients who have experienced headaches, seizures, or strokes, or who have such disorders as Alzheimer's disease, Huntington's disease, meningitis, multiple sclerosis, muscular dystrophy, and Parkinson's disease.

A neurologist begins an evaluation by asking the patient to fully describe the problem. The neurologist then examines the patient's nervous system. The examination includes an evaluation of the patient's mental functioning, emotional state, vision, hearing, speech, strength and reflexes, coordination, and perception of touch, pain, and temperature. The neurologist also uses specialized imaging techniques to view the affected tissues and organs. These techniques include angiography, computerized tomography, and magnetic resonance imaging. See **Angiography; Magnetic resonance imaging.**

The neurologist interprets all this information to make a diagnosis and to determine treatment. The neurologist may prescribe medications or recommend physical therapy or surgery.

Neuron. See **Nervous system.**

Neuropathology is the science that studies alterations produced by diseases of the central nervous system, nerves, or muscles. It is also concerned with changes that result from normal activity in the nervous system. These may be changes in appearance that can be seen with the unaided eye or with an optical or electron microscope. See also **Nervous system; Pathology.**

Neuroptera. See **Insect** (table).

Neurosis is a term used in a number of ways in the field of mental health. The term refers both to certain types of mental disorders and to a particular type of psychological mechanism.

Neurosis as a disorder. Most psychiatrists and other mental health experts use the term *neurosis,* or *neurotic disorder,* for any of a group of mild mental illnesses. Neuroses are characterized by such symptoms as anxiety, insecurity, depression, and unreasonable fears. Most people have these feelings occasionally. But a person who suffers a neurotic disorder has them frequently or even constantly. Such feelings interfere with the individual's life and relations with others.

Neurotic disorders seldom disable a person totally. Individuals who have a neurotic disorder recognize the symptoms as unacceptable and strange. Unlike those with more severe mental illnesses called *psychoses,* people with a neurosis can distinguish between reality and imagination (see **Psychosis**). Neurotic disorders do not include mental problems that seem to have a physical cause. One such problem is the loss of memory that sometimes occurs with aging.

Neuroses formerly made up one of the major diagnostic groups of mental disorders as classified in the United States, the United Kingdom, and elsewhere. This group included such conditions as *anxiety neurosis, phobias, hypochondriasis,* and *obsessions* and *compulsions.* Anxiety neurosis is a disorder characterized by intense, baseless worry. Phobias are unreasonable fears of certain situations or activities, such as open spaces or travelling in aeroplanes. Hypochondriasis is an abnormal fear that one has a disease. Obsessions and compulsions are senseless thoughts and acts that a person feels forced to repeat.

In 1980, psychiatrists in the United States reorganized their diagnostic classifications and adopted more specific terms for many disorders. The revised classification was adopted in a number of countries, including the United Kingdom. The neuroses classification was dropped, and the conditions formerly in that group were placed in other categories. Many mental disorders were renamed. For example, the term *anxiety neurosis* was replaced by *panic disorder* and *generalized anxiety disorder.* Many psychiatrists disagreed with the elimination of neuroses as a diagnostic group.

Neurosis as a psychological mechanism forms part of the theory developed by the Austrian psychiatrist Sigmund Freud and his followers. In this theory, the term *neurosis* describes a neurotic process that produces certain symptoms. The process begins with an unconscious conflict between opposing desires or between a desire and a prohibition. For example, an unconscious feeling of aggression, such as a desire to harm someone physically, might conflict with feelings of guilt. The unconscious awareness of the conflict produces a mental barrier called a *defence mechanism.* This barrier keeps unwanted feelings out of a person's conscious awareness. To avoid feeling guilty, an individual might *repress* (hold back) a desire to harm someone. Such a defence mechanism, in turn, produces a symptom. For example, the person might have an abnormal fear of objects that could be used to actually carry out the repressed desire to cause harm. Freud believed such disturbances arose from distressing experiences that had occurred during childhood.

Related articles in *World Book* include:

Anxiety
Freud, Sigmund
Hysteria
Mental illness
Phobia
Psychoanalysis

Neuter gender. See **Gender.**

Neutering. See **Pet** (Birth control).

Neutra, Richard Joseph (1892-1970), was an Austrian-born architect who worked in California, U.S.A. His best designs demonstrate his goal of creating buildings that meet biological and psychological needs, as well as artistic and technical considerations. In his book *Survival Through Design* (1954), Neutra stated that people can survive only by controlling their environment through design, architecture, and city planning.

Neutra's Lovell House in Los Angeles was one of the first homes in America with a light steel frame and an open plan.

Neutra was born in Vienna. He moved to the United States in 1923 and settled in Los Angeles in 1925. His most famous work is the Lovell "Health" House (1929) in Los Angeles, one of the earliest examples of modern European architecture in the United States. His later buildings, including the Tremaine House (1948) in Santa Barbara, California, often suggest a continuous flow of space by the use of vast sheets of glass and thin supports.

Neutrality is the official status of a government that does not take part in a war. The nations that do not take part, either directly or indirectly, are called *neutrals.* The warring countries are called *belligerents.* Belligerents want to defeat their enemies and prevent neutrals from trading with them. Neutrals want to stay out of the war, and expect the belligerents to respect neutral territory, freedom of the seas, and the right to trade. *Neutralization* describes the position of a country recognized as permanently neutral, such as Switzerland.

Since the late 1700's, the rights and duties of neutrals and belligerents have become part of international law. But warring nations have frequently ignored these rights and duties, and in most cases it has been difficult or impossible to enforce them. The rules of neutrality have been developed through both custom and treaty. In 1907, a group of nations at the second Hague Peace Conference set down in two treaties the traditional rules of neutrality on land and sea. These rules were an attempt to balance the differing, and often conflicting, interests of neutrals and belligerents. Individual governments also pass their own laws on neutrality.

Rights and duties. Traditionally, a neutral must not provide military assistance to either of the belligerents. In return, belligerents must respect the rights of neutrals. They must not fight on neutral territory, or move troops across neutral countries. If belligerent troops enter neutral territory, the neutral has the right to disarm them and *intern* (hold) them until the war is over.

Belligerent warships may enter a neutral port in an emergency. But if they stay more than 24 hours, they can be interned. Belligerents may not use neutral ports for naval operations.

Neutrals have the right to trade with other neutrals. But belligerents may search neutral ships. If these ships are carrying war materials to the enemy, the belligerent has the right to seize the goods. Belligerents often decide for themselves what to consider as war materials. They may blockade enemy ports and seize neutral vessels that try to *run* (slip through) the blockade.

Permanent neutrality Certain countries have long been permanently neutral.

Switzerland, whose beginnings as a nation date back to the late 1200's, refused to take sides in a European war as early as the 1500's. Since Switzerland's modern borders were defined by treaty in 1815, its neutrality has been recognized internationally. Switzerland has been at peace with the world since 1815 and has refused to join any political alliances. It is not a member of the European Community (EC), also known as the Common Market.

Sweden has also been neutral since the 1800's. It has stayed out of all wars and not entered any military alliances. In World War II (1939-1945), following Germany's conquest of Norway in 1940, Sweden allowed German forces to pass through its territory on their way to occupied Norway. This policy was stopped in 1943. Since World War II, Sweden has taken an active part in many international organizations, including the United Nations.

Austria has been neutral since 1955, the year in which a treaty was agreed for ending its occupation by the Four Allied powers (the United States, the Soviet Union, Britain, and France). Austria has used its neutral position in international affairs to provide a bridge between East and West. Austria is a member of the EC.

Ireland. The Irish Free State, which came into existence in 1922, remained neutral throughout World War II, although many Irish people joined the British armed forces. The Free State became the Republic of Ireland in 1948 and has since retained its neutrality. But it is an active member of the United Nations, contributing to that organization's peacekeeping initiatives, and is a member of the EC.

Finland has an agreement with the Soviet Union under the Finno-Soviet Pact of Friendship, Cooperation, and Mutual Assistance, signed in 1948 and renewed several times since. Under this pact, Finland must repel any attack made through its territory upon the Soviet Union by the Federal Republic of Germany or its allies. In the realm of international affairs, however, Finland is recognized as neutral.

Neutrality and the two World Wars. Some countries who became involved in the two World Wars of the 1900's at first attempted to remain neutral. During World War I (1914-1918), Germany violated the laws of neutrality at the start of the war by invading Belgium, whose permanent neutrality had been guaranteed by treaty in 1831. The United States remained neutral in World War I from 1914 to 1917. During this time, the U.S. defended its neutrality at sea against Britain, France, and Germany. Britain and France stopped U.S. cargo ships bound for Denmark and Norway, believing the cargoes would end up in Germany. In 1917, German submarines attacked and sank U.S. ships without warning. The United States declared war on Germany.

In World War II, the United States at first sought to remain neutral. But they were drawn into the war as a result of Japan's attack on Pearl Harbor in 1941.

Neutrality today. Total warfare and the growth of organizations like the United Nations have made neutrality more difficult to define. Total warfare has erased many distinctions between civilian and military activities and materials. This undercuts many of the arguments neutrals previously used to support their rights of neutral trade. Collective action, such as use of a UN police force against an aggressor, is in many ways in disagreement with earlier practices of neutrality.

The year 1991 saw the dissolution of the Soviet Union, the leading Communist country during the Cold War. The idea of opposing blocs began to lose meaning but how this will affect issues of neutrality and nonalignment remains to be seen.

See also **High seas; International law.**

Neutralization is a chemical reaction in which an acid and a base form a salt and water. If the reaction is complete, the final salt solution is usually *neutral* (neither acidic nor basic). Neutralization is one of the most important reactions in chemical analysis, and in many branches of industry. Processes that go on in the human body include neutralization.

Acids and bases in water solution *ionize* (break down) into positive and negative ions as shown below for hydrochloric acid (HCl) and sodium hydroxide (NaOH).

$$\mathrm{HCl} \rightarrow \mathrm{H^+} + \mathrm{Cl^-} \text{ and } \mathrm{NaOH} \rightarrow \mathrm{Na^+} + \mathrm{OH^-}$$

When the acid and base react together, the hydroxide (OH^-) ion from the base combines with the hydrogen (H^+) ion from the acid to form water (H_2O).

$$\mathrm{H^+} + \mathrm{Cl^-} + \mathrm{Na^+} + \mathrm{OH^-} \rightarrow \mathrm{Na^+} + \mathrm{Cl^-} + \mathrm{H_2O}$$

The two remaining ions form a salt that usually stays in solution as ions. If the water is evaporated, the salt can be recovered in crystal form. Neutralization is more specifically defined as the reaction between hydroxide and hydrogen ions to form water. Chemists can tell when a neutralization reaction is complete by using indicators, such as litmus.

Related articles in *World Book* include:

Acid
Base
Ion
Litmus
pH
Phenolphthalein
Salt, Chemical

Neutrino is any of several types of subatomic particles that have no electrical charge or measurable mass. Neutrinos travel at or near the speed of light. They are produced when unstable atomic nuclei or subatomic particles disintegrate. Neutrinos belong to the *lepton* family of particles, which includes electrons and two heavier types called *muons* and *taus* (see **Lepton**). Neutrinos can be transformed into charged leptons by colliding with atomic nuclei. A type of neutrino called an *electron-neutrino* can only be transformed into an electron. *Mu-* and *tau- neutrinos* change only into muons and taus. Neutrinos have counterparts called *antineutrinos.* They also have no electrical charge and an unmeasurable mass, but differ from neutrinos in the direction of their spin. See **Antimatter.**

Neutrinos interact with matter only through a form of electromagnetic force called the *weak interaction.* Because this force acts at extremely short distances, neutrinos can pass through solid matter with only a slight chance of a collision. For example, a beam of neutrinos can travel entirely through the earth with no significant loss in strength. The ability of neutrinos to penetrate matter makes them useful in the study of nuclear particles. Physicists have learned much about the makeup of neutrons and protons by observing rare collisions between neutrinos and atomic nuclei. The neutrinos are produced by devices called *particle accelerators.*

Some nuclear reactions that occur deep within the sun produce neutrinos. Such neutrinos provide the only direct means of studying the sun's interior. In addition, scientists have theorized that neutrinos carry off much of the energy released by exploding stars called *supernovae.*

See also **Particle accelerator; Pauli, Wolfgang.**

Neutron is a subatomic particle. Neutrons, together with other subatomic particles called *protons,* form the nuclei of all atoms except ordinary hydrogen, whose nucleus consists of a single proton (see **Proton**). Neutrons and protons make up 99.9 per cent of an atom's mass. A cloud of *electrons* around the nucleus accounts for the rest of the mass (see **Electron**). In the nucleus, neutrons and protons are held together by a force known as the *strong interaction* or the *strong nuclear force.*

The number of neutrons in an atom of any chemical element is equal to the difference between the element's *mass number* (total number of protons and neutrons) and its *atomic number* (number of protons). The atoms of lighter elements contain about an equal number of neutrons and protons. Heavier elements contain more neutrons than protons.

Neutrons consist of fundamental particles called *quarks* (see **Quark**). A neutron has no electric charge. Its diameter is approximately 0.000000000001 millimetre. The mass of a neutron is slightly greater than that of a proton. A free neutron decays into a proton, an electron, and an antineutrino. A free neutron has a half-life of about 10.4 minutes.

Sir James Chadwick, a British physicist, discovered the neutron in 1932. Today, scientists use neutrons to make various elements radioactive. They bombard atoms of the elements with neutrons in a nuclear reactor. After the nuclei of the atoms absorb neutrons, they decay by giving off radiation. When a nucleus of the uranium isotope U-235 is struck by a neutron, it becomes unstable and splits into two nearly equal parts. This process, called *fission,* releases a huge amount of energy and frees additional neutrons that cause more uranium nuclei to fission. A continuous series of such fissions, called a *nuclear chain reaction,* produces the energy in nuclear weapons and reactors.

See also **Atom; Nuclear energy; Chadwick, Sir James; Radioactivity; Baryon.**

Neutron bomb. See **Nuclear weapon** (Recent developments).

Neutron star is the smallest and densest type of star known. Neutron stars measure only about 10 kilometres across, but they have even more matter than the sun. If the period at the end of this sentence were made of neutron star material, it would weigh as much as a fully loaded supertanker.

A neutron star forms when a large star—six to eight times more massive than the sun—runs out of fuel to burn. As a result, the star collapses and then explodes. The exploding star, called a *supernova,* throws off its outer layers and leaves behind a spinning core (see **Supernova**). The core is the neutron star. It consists of protons and electrons that have been squeezed together to form neutrons by intense gravitational force.

A neutron star has a magnetic field billions of times stronger than the most powerful magnets on earth. This magnetic field acts like a particle accelerator. It creates an electric field that rips electrons and protons from the star's surface. In some cases, these particles produce a beam of radio waves, X rays, or other radiation that flows from the star.

Physicists predicted the existence of neutron stars in 1938. The prediction was only a theory until 1967, when radio telescopes in England picked up regular bursts of radio waves from an object in space. Scientists later concluded that such objects, called *pulsars,* are actually neutron stars (see **Pulsar**).

Neutrophil. See **Blood** (Neutrophils).

Neva River is a link in three waterway systems in the Soviet Union. Only 72 kilometres long, it rises at the southern end of Lake Ladoga and flows west into the Gulf of Finland at Leningrad. It is part of the Ladoga-Volga system that connects the Baltic and Caspian seas. It is also a link in the system that connects the Baltic and White seas.

Nevada (pop. 1,206,152) is a state in the western United States. It is the only U.S. state whose laws allow most kinds of gambling throughout the state. Luxurious gambling casinos in Lake Tahoe, Las Vegas, and Reno attract visitors from all parts of the world.

Nevada is one of the largest U.S. states in area, but has one of the smallest populations. Las Vegas is the largest city and chief tourist attraction, and Reno is the second largest city.

Nevada is one of the Rocky Mountain States. It is a land of snow-capped mountains, grassy valleys, and sandy deserts.

Nevada covers 286,352 square kilometres. It lies almost entirely within the Great Basin, a huge desert area in western United States. There are more than 30 mountain ranges in the state. Between the mountains lie *buttes* (lone hills) and *mesas* (tablelike mountains). In many places, geysers erupt and hot springs gush.

Nevada reaches its lowest elevation, 143 metres, at the southern tip of the state. Boundary Peak, the highest point, rises 4,005 metres near the southwestern border.

Nevada has less rain than any other state. Temperatures there average 23° C in July, and −1° C in January.

The tourist industry provides the state's single greatest source of income. Heavy tourist spending benefits hotels, restaurants, and ski resorts. Most of Nevada's service industries are concentrated in the Las Vegas and Reno metropolitan areas. The U.S. government employs many people at the Nevada Test Site and Nellis Air Force Base. The Nevada Test Site is a nuclear weapons testing facility.

Nevada is a leading gold-mining state. Agriculture and manufacturing are of minor importance in Nevada. Cattle ranching is the chief agricultural activity, and electronic equipment is the chief manufactured product.

Indians may have lived in the Nevada region more than 20,000 years ago. Explorers of the early 1800's encountered Mohave, Paiute, Shoshone, and Washoe Indians.

The United States acquired the Nevada region from Mexico in 1848. In 1859, the discovery of silver near Virginia City brought a rush of prospectors to the area. Nevada's nickname, the *Silver State,* comes from the vast amounts of silver once taken from its mines. Settlers chose the name *Nevada,* a Spanish word meaning *snowclad,* when the region became a territory in 1861. Nevada became a U.S. state on Oct. 31, 1864.

Tourism continues to be the state's fastest-growing industry. Air and water pollution have become serious problems. Conservation laws were passed in 1980 to protect Lake Tahoe.

Nevelson, Louise (1900-1988), was an American sculptor. She became best known for her *assemblages,* often grouped within boxlike frames. Many of the large black walls of her compartments express a feeling of quiet and majesty.

Most of Nevelson's assemblages are made out of wood that is painted either black or gold or left in the natural colour. She also constructed "total environments" of everyday "found" objects and utensils, strips of moulding, woodwork decorations, or Victorian debris that form powerful unified wholes.

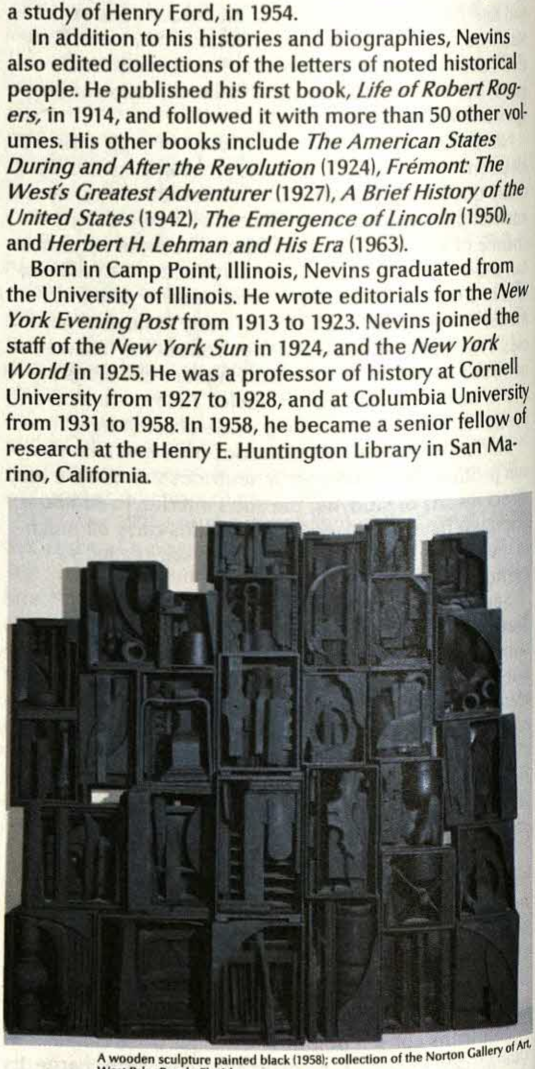
Nevelson was born in Kiev, Russia, and moved to the United States in 1905. She studied painting at the Art Students League in New York City.

Nevins, Allan (1890-1971), an American historian and educator, twice was awarded the Pulitzer Prize for biography. *Grover Cleveland: A Study in Courage* won the prize in 1933, and *Hamilton Fish: The Inner History of the Grant Administration* received the award in 1937. He won the Bancroft Prize and the Scribner Centenary Prize for *The Ordeal of the Union* (1947).

Nevins' *John D. Rockefeller,* a biography published in 1940, became very popular. It was revised and republished in 1953 as *Study in Power: John D. Rockefeller, Industrialist and Philanthropist.* Nevins and Frank Ernest Hill completed *Ford: The Times, the Man, the Company,* a study of Henry Ford, in 1954.

In addition to his histories and biographies, Nevins also edited collections of the letters of noted historical people. He published his first book, *Life of Robert Rogers,* in 1914, and followed it with more than 50 other volumes. His other books include *The American States During and After the Revolution* (1924), *Frémont: The West's Greatest Adventurer* (1927), *A Brief History of the United States* (1942), *The Emergence of Lincoln* (1950), and *Herbert H. Lehman and His Era* (1963).

Born in Camp Point, Illinois, Nevins graduated from the University of Illinois. He wrote editorials for the *New York Evening Post* from 1913 to 1923. Nevins joined the staff of the *New York Sun* in 1924, and the *New York World* in 1925. He was a professor of history at Cornell University from 1927 to 1928, and at Columbia University from 1931 to 1958. In 1958, he became a senior fellow of research at the Henry E. Huntington Library in San Marino, California.



A wooden sculpture painted black (1958); collection of the Norton Gallery of Art, West Palm Beach, Florida

Louise Nevelson's *Sky Cathedral* is typical of the complex and mysterious wooden constructions that have made her famous.

Nevins lectured on American history at universities in other countries. He served as a special representative for the Office of War Information in Australia and New Zealand in 1943 and 1944, during World War II.

Nevis. See **Saint Christopher and Nevis.**

Nevis, Ben. See **Ben Nevis.**

New Britain is the largest of the more than 300 islands in the Bismarck Archipelago, which forms part of the nation of Papua New Guinea. New Britain lies off the northeast coast of New Guinea. The island covers 36,500 square kilometres.

About 312,000 people live on New Britain. Almost all are Melanesians. The people fish and farm for a living. Most of the farming is done along the coasts. The island's north end is the most fertile area in Papua New Guinea. Rabaul is the island's largest urban community and port. It lies along the coast and has several active volcanoes around it. Rabaul suffered much damage in 1937 and 1994 when these volcanoes erupted.

In 1700, the English navigator William Dampier reached New Britain. In 1884, it became a part of a German empire. Australian forces took the island from Germany in 1914 during World War I. It was given to Australia as a mandate of the League of Nations in 1920. Japan captured Rabaul in 1942, during World War II, and held the area until 1945. During the war, bombing raids destroyed most of Rabaul, but the city was rebuilt. Australia regained control of the area after the war. In 1975, New Britain became part of the newly independent nation of Papua New Guinea.

See also **Bismarck Archipelago.**

New Brunswick (pop. 723,900) is one of the four Atlantic Provinces of Canada. Forests cover about 90 per cent of the land. Saint John is New Brunswick's largest city and chief industrial and shipping centre. Fredericton is the capital.

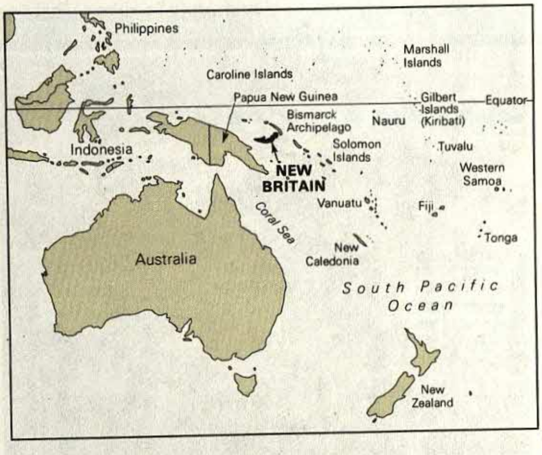
Service industries provide 72 per cent of New Brunswick's gross domestic product. Manufacturing accounts for 13 per cent. The leading service industry is made up of community, social, and personal services. The leading manufacturing activity is food processing.

New Caledonia is an overseas territory of France. It is situated in the southwest Pacific Ocean, about 2,000 kilometres northeast of Sydney, Australia. For the location of New Caledonia, see **Pacific Islands** (map).

The territory of New Caledonia consists of one main island, also called New Caledonia; the Loyalty Islands; The Bélep Islands; the Isle of Pines; and a few uninhabited islands. The mountainous main island covers 16,749 square kilometres. The rest of the islands have a total area of only 2,330 square kilometres.

The climate of New Caledonia is pleasant, with temperatures ranging from 24 °C in July to 30 °C in January. From April to November is the cool, dry season, and the hot, wet weather occurs from December to March.

New Caledonia has a population of about 165,000. Melanesians, the largest group of people, make up about two-fifths of the population. Europeans form the second largest population group. Other groups include Indonesians, Polynesians, and Vietnamese.



Location of New Britain

The Melanesians are the original inhabitants of New Caledonia. They speak 27 distinct languages and many dialects. Some Melanesians in rural villages live in huts made of coconut fronds and rushes, but most live in concrete houses with corrugated iron roofs. The Melanesian people of New Caledonia are noted for their vigorous ceremonial dance, the *piloupilou.* The Loyalty Island people are known for their dance, the *tchap-tchap.*

The Indonesians and Vietnamese in New Caledonia are mainly descendants of *indentured* (contract) labourers brought to the island in earlier times. They have retained many of the customs and life styles of their homelands. Many of the people from other Pacific islands work in the nickel mines or at the nickel smelter.

Economy. Nickel mining is the most important industry in New Caledonia, which is, after Canada, the second largest producer of nickel in the world. The ore is extracted from open-cast mines at Poro, Nepoui, and Thio.

Melanesians, the original inhabitants of New Caledonia, play their own type of cricket, introduced by British missionaries.

Nouméa, the capital of New Caledonia, is the only city on the main island of the territory, also called New Caledonia.

The nickel smelter is located at Doniambo, on the outskirts of Nouméa, where the ore is refined to about 80 per cent purity. New Caledonia produces approximately 70,000 metric tons of ferro-nickel mattes a year.

Tourism is the second most important industry. In the early 1980's, nearly 80,000 people visited New Caledonia in one year, not including about 43,600 cruise ship passengers. But political violence has caused the number of visitors to decline. Nouméa has several luxury hotels. Many visitors go to the world-famous aquarium at Anse Vata, a beach near Nouméa, and to the former penal colony at Ile Nou. The Isle of Pines is also a popular resort.

The breeding of livestock, cattle, goats, pigs, and horses is important in the economy. New Caledonia also exports copra and coffee.

Transport and communications. Regular shipping services connect Nouméa with many parts of the world. Smaller ships sail within New Caledonian waters and to neighbouring Pacific Islands countries. Regular flights serve the modern international airport at Tontouta, located about 50 kilometres from Nouméa.

Education is compulsory, and about half of New Caledonian children attend private schools. The rest attend free state schools. France largely finances the secondary school system, and students sit French public examinations. The language of instruction is French, and some attempt has been made to produce relevant school materials for Melanesian students. The government offers scholarships for further study in France.

Government. The French government appoints a high commissioner, who has considerable powers, as its representative in New Caledonia. An elective territorial assembly of 36 members debates and approves the territorial budget submitted by the administration.

The assembly may also express its desires on policy matters outside the jurisdiction controlled from Paris. The governor meets, as executive, with the *Conseil de Gouvernement* (advisory council), of which the governor is president. The other members are elected by the territorial assembly. New Caledonia has two representatives in Parliament. The territory's voters elect a deputy to the French National Assembly and a senator to the French Senate. New Caledonia also has a representative on France's economic and social council.

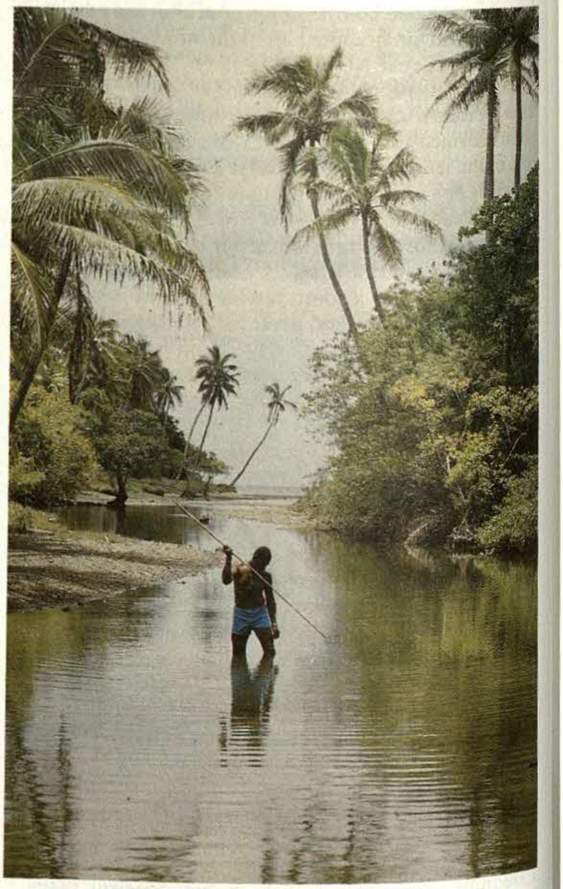
History. The original inhabitants of New Caledonia were probably immigrants from Papua. Some Loyalty Islanders are of Polynesian origin. The first European to visit New Caledonia was James Cook. He landed at Balade, on the northeast coast, on Sept. 4, 1774.

In 1843, French Catholic missionaries established a mission at Balade. Rear Admiral Febvrier-Despointes took possession of the island for France in 1853, after a party of Melanesians had killed and eaten the crew of a French survey ship in 1850.

France used Ile Nou and the Isle of Pines for the transportation of convicts from 1864 to 1897. Many of the men were political deportees. For several decades after transportation ceased, they and their families made up most of the European population. In 1863, nickel was discovered and a rush began in the 1870's.

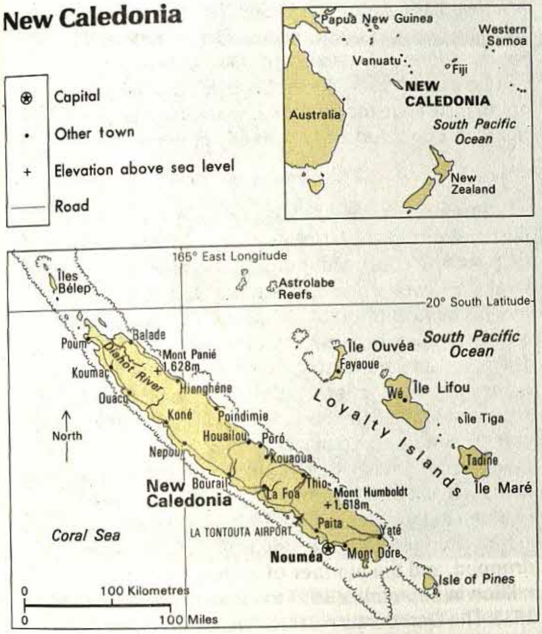
During World War II (1939-1945), New Caledonians declared their support of the Free French forces. The island became a key point in the defence of the western Pacific. Many troops from the United States, Australia, and New Zealand were stationed on the main island.

In 1951, the government abolished the indentured labour system, under which about 13,000 Chinese, Indonesian, and Vietnamese had worked in New Caledonia.



Spearfishing in local rivers is one of the traditional Melanesian activities still practised in rural parts of tropical New Caledonia.

New Caledonia



Most of these people were returned to their homelands in the early 1960's.

Since 1982, the Melanesians, realising they would soon be outnumbered by French settlers, have agitated strongly and sometimes violently for independence. The French government has granted them some concessions. But the Melanesians have continued to demand independence. In 1988, violence erupted between some Melanesians and French officials. Later that year, voters approved a peace agreement that provided for a referendum on independence in 1998.

New city. See City (Future cities); **Town planning.**

New Deal was President Franklin D. Roosevelt's programme to pull the United States out of the Great Depression in the 1930's. The New Deal did not end the depression. But it relieved much economic hardship and gave Americans faith in the democratic system at a time when other nations hit by the depression turned to dictators. Roosevelt first used the term *new deal* when he accepted the Democratic presidential nomination in 1932. "I pledge you, I pledge myself, to a new deal for the American people," he said.

When Roosevelt became President on March 4, 1933, business was at a standstill. The stock market crash in October 1929 had shattered the prosperity most Americans enjoyed during the 1920's. The depression grew worse during the early 1930's. Banks, small businesses, and factories closed. Workers lost their homes and farmers lost their farms because they could not meet mortgage payments. An estimated 12 to 15 million Americans—1 out of 4 workers—had no jobs.

In his inaugural address, Roosevelt expressed confidence that the nation could solve its problems. "The only thing we have to fear is fear itself," he said.

The Hundred Days

Roosevelt called Congress into special session on March 5, 1933. From March 9 to June 16, Congress passed a series of important laws aimed at speeding economic recovery, providing relief for victims of the depression, and reforming financial, business, agricultural, and industrial practices. Most laws passed swiftly and with little opposition. Never before had Congress approved so many important laws so quickly. The session then became known as *The Hundred Days.*

The programmes and policies that made up the New Deal did not come from one man. Some were Roosevelt's ideas. Others were proposed by members of the "Brain Trust," a group of unofficial presidential advisers. Congressional leaders suggested others. Some programmes conflicted with each other. For example, the Economy Act cut the salaries of federal employees while the Public Works Administration increased government spending. But Roosevelt was willing to experiment and tried the ideas of one group and then another.

Helping savers and investors. Roosevelt's first goal was to end the banking crisis. A wave of bank failures in February had frightened the public. Depositors rushed to withdraw their money before their banks failed. Roosevelt declared a "bank holiday," closing all banks on March 6. On March 9, Congress passed the Emergency Banking Act. The new law allowed government inspectors to check each bank's records and to reopen only those banks that were in strong financial condition. Within a few days, half the nation's banks reopened. These banks held 90 per cent of the country's total deposits. This action did a good deal to end the nation's panic.

The Glass-Steagall Banking Act of June 1933 provided further protection for investors. It gave the Federal Reserve Board more power to regulate loans made by banks and created the Federal Deposit Insurance Corporation (FDIC), which first insured bank deposits up to 2,500 U.S. dollars and later up to 5,000 U.S. dollars.

New Deal projects, such as this road construction project in New York City, put many Americans back to work. The New Deal helped the U.S. recover from the Great Depression.

The Securities Act of 1933, also called the Truth-in-Securities Act, required firms issuing new shares to give investors full and accurate financial information. Congress created the Securities and Exchange Commission (SEC) in 1934 to regulate the sale of securities and to curb unfair stock market practices.

Helping the farmers. The Agricultural Adjustment Administration (AAA), created in May 1933, tried to raise farm prices by limiting production. The AAA used funds raised through a tax on processors of farm products to pay farmers not to produce as much as they had before. Farmers limited production by not planting crops on part of their land. The plan increased farm income, but critics said farmers should not cut food and cotton production at a time when people were hungry and needed clothing. The Supreme Court of the United States declared the AAA unconstitutional in 1936. The government then paid farmers to leave some land vacant as part of new soil conservation programmes.

Helping industry and labour. The National Industrial Recovery Act of June 1933 was one of the most important of the new laws. This act created the National Recovery Administration (NRA) to enforce codes of fair practices for business and industry. Representatives of firms within each industry wrote the codes.

The industrial codes set minimum wages and maximum hours, and supported the right of workers to join unions. The codes primarily aided business. They allowed member firms to set standards of quality and establish the lowest prices that could be charged for goods. The Supreme Court declared the NRA unconstitutional in 1935.

Helping the needy. The Civilian Conservation Corps (CCC) launched the New Deal relief programme. The CCC put young men from needy families to work at useful conservation projects, such as planting trees and building dams. The Federal Emergency Relief Administration provided the states with money for the needy. The Public Works Administration (PWA) created jobs for large numbers of people. Thousands of schools, courthouses, bridges, dams, and other useful public works projects were built through PWA projects. The Home Owners Loan Corporation (HOLC) provided money at low interest for people struggling to pay mortgages. The Tennessee Valley Authority (TVA) built many dams to control floods and to provide electricity for residents of the Tennessee River Valley.

The Second Hundred Days

Congress approved several important relief and reform measures in 1935. These laws became the heart of the New Deal's lasting achievements. Most of the new laws were passed during the summer, and some historians call this period *The Second Hundred Days.* Some of the most important new measures were the Works Progress Administration (WPA), the National Labor Relations Act, and the Social Security Act.

Works Progress Administration provided jobs building highways, streets, bridges, parks, and other projects intended to have long-range value. It also created work for artists, writers, actors, and musicians. The WPA provided some work for about $8\frac{1}{2}$ million people.

The National Labor Relations Act guaranteed workers the right to organize unions. During the next few years, the American Federation of Labor (AFL) and the new Congress of Industrial Organizations (CIO) enrolled millions of workers in trade unions.

The Social Security Act provided pensions for the aged, insurance for the jobless, and payments for the blind and disabled and for needy children.

The final measures

Roosevelt proposed a plan to add justices to the Supreme Court in 1937. Critics charged that he was trying to "pack" the court with judges who favoured the New Deal. Roosevelt's plan divided the Democrats and cost him his solid support in Congress. Congress passed only two other important reform measures after that. The first was the Housing Act of 1937, which provided money for more federal public housing projects. The second was the Fair Labor Standards Act of 1938, which set a minimum wage of 25 cents an hour and a maximum working week of 44 hours, with extra pay for extra hours. This act also banned children under 16 from working in factories, and during school hours.

The economy faltered late in 1937. Farm prices dropped, and the number of jobless rose from about 5 million in September 1937 to almost 11 million in May 1938. The Democrats retained majorities in both houses of Congress in the 1938 elections, but Republicans gained back seats for the first time since 1928. Strong opposition in Congress forced Roosevelt to avoid further reforms, and he soon became occupied primarily with the growing threat of Nazi Germany.

Results of the New Deal

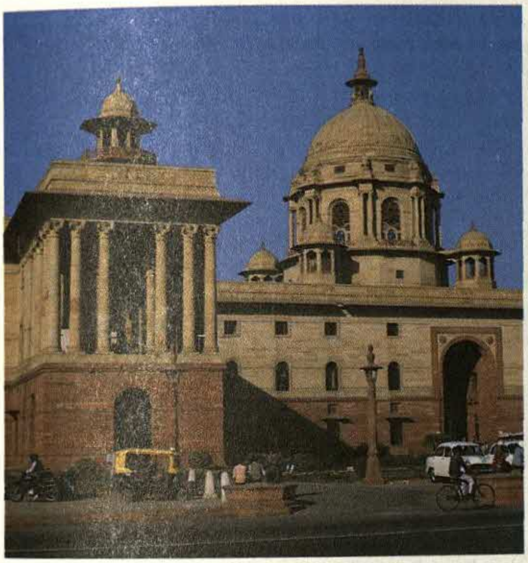
Most scholars agree the New Deal relieved much economic distress and brought about a large measure of recovery. But about 8 million Americans still had no jobs in 1940. Military spending for World War II, rather than the New Deal, brought back prosperity.

The New Deal tried to spend its way back to prosperity. It spent billions of dollars to create jobs for unemployed people, and altogether New Deal programmes cost more money than the government received through taxes. The government borrowed much of the money it needed by selling bonds, and the federal debt grew from $22\frac{1}{2}$ billion U.S. dollars in 1933 to about $40\frac{1}{2}$ billion U.S. dollars in 1939.

The New Deal caused major political changes. The Democratic Party, generally a minority party since the Civil War, became the largest political party. Its main strength shifted from the rural South to the urban North. Immigrants, union members, urban intellectuals, and reformers gained a stronger voice in party decisions.

Most scholars also agree that the New Deal preserved the essentials of the American free enterprise system. Profits and competition continued to play a leading part in the system. However, the programme added new features. The federal government assumed responsibility for the economic security of the people and the economic growth of the nation. After the New Deal, the government's role in banking and public welfare grew steadily. Also, organized labour became an important force in national affairs.

New Delhi (pop. 301,297) is the capital of India. The city lies on the west bank of the Jumna River in northern India, near the edge of the Thar, or Great Indian, Desert.



The Presidential House in New Delhi is the official residence of the president of India. The majestic structure, which has 340 rooms, originally served as the home of the British viceroy when India was part of the British Empire.

New Delhi is about 5 kilometres south of Delhi, the former capital. For location, see **India** (political map).

New Delhi is an attractive, spacious city. It contrasts sharply with the crowded, older city of Delhi. The design of New Delhi and some of its buildings reflects the influence of the British, who ruled India from 1858 to 1947. New Delhi was built in the early 1900's to replace Delhi as India's capital. It became the capital in 1931.

The city. New Delhi is a carefully planned city. It has wide, treelined avenues, and many gardens and open areas. Huge government buildings, including Parliament House and a government office building called the Secretariat, dominate the centre of the city. Large houses, originally built for government officials, and smaller houses for servants are nearby.

Rashtrapati Bhavan (Presidential House), the official residence of the president of India, stands west of the Secretariat. This majestic, copper-domed palace has 340 rooms. Several blocks east are white palaces that once served as the winter homes of Indian princes. The government turned most of the palaces into offices or museums after India became independent in 1947. The National Sports Stadium, which seats 30,000 spectators, is east of the palaces.

The southern part of the city includes the Diplomatic Enclave, an area set aside for foreign embassies and fine residences. High government officials of other countries have offices on a street called *Shanti Path* (Peace Boulevard). A temple of the Bahá'í faith is located south of the capital. The temple, built in the shape of a lotus blossom, was completed in 1986.

New Delhi has many small neighbourhoods and suburbs with distinctive bazaars. Many of these neighbourhoods were settled by refugees from the section of India that became part of Pakistan in 1947. New Delhi also has several beautiful gardens, of which the Mogul Gardens at Rashtrapati Bhavan are the best known.

Connaught Place, the business centre of New Delhi, lies north of the Secretariat and Parliament House. It is surrounded by a fashionable shopping area where shoppers can buy books, fabrics, furniture, jewellery, toys, and other products.

Economy. The government of India is the main employer in New Delhi. The city has no factories. Craftworkers sell products in the Central Cottage Industries Emporium, a building near Connaught Place.

History. In 1912, the capital of India was moved from Calcutta to Delhi. Plans were also made to build a new capital just outside Delhi, away from that crowded city. The English architects Sir Herbert Baker and Sir Edwin Lutyens planned the layout and designed buildings for the new city. Construction began in 1912 but was delayed during World War I (1914-1918). In 1931, New Delhi was completed and became the capital of India. The city remained the capital after India gained independence from the United Kingdom in 1947. India's constitution went into effect on Jan. 26, 1950. Since then, January 26 has been a national holiday called Republic Day. New Delhi has an annual Republic Day celebration, which features a huge parade.

See also **Delhi; India** (picture: Parliament House).

New Economic Mechanism. See **Hungary** (Economy).

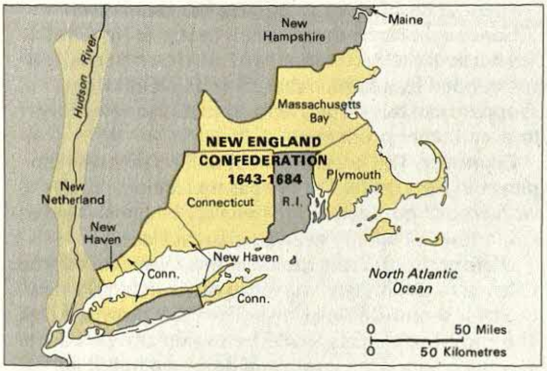
New England is a region in northern New South Wales, Australia. It is the largest area of high land in Australia. The area is not well defined. But most people consider it to include the plateau region that extends from the Macintyre River and the Queensland border in the north to the Moonbi Ranges, near Tamworth, in the south. The coastal districts of northern New South Wales form the eastern boundary of New England. The Western Slopes of the Great Dividing Range form the region's western boundary.

The plateau covers an area of more than 23,300 square kilometres. The average height of this area is a little more than 914 metres above sea level. The area has a number of mountains that are about 1,525 metres high. These mountains include Round Mountain (1,615 metres), Point Lookout (1,600 metres), Ben Lomond (1,520 metres), and Capoompeta (1,510 metres).

The height of the region makes it a good area for growing such crops as stone fruit and potatoes, which thrive in colder climates. Farmers in the area send large quantities of these crops to Sydney. Farmers rear sheep and breed cattle. The towns in the area include Armidale, Tamworth, Inverell, Glen Innes, and Tenterfield.

The University of New England was established at Armidale in 1954. In a referendum held in 1967, a majority of more than 30,000 rejected a proposal that New England should become a separate state.

New England, Dominion of, was a group of English colonies in America united in 1686 by King James II of England. The colonies in the dominion were Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Plymouth, and Rhode Island. King James believed the colonies could function best under a single government. But the colonists had no voice in the government, and most of them opposed the dominion. James was overthrown in England in 1688. The dominion broke up the next year.



The New England Confederation was formed in 1643 by four New England colonies. The confederation hoped to discourage attacks by New Netherland, other nearby colonies, and Indians.

New England Confederation was organized in 1643. Four English colonies in the United States—Massachusetts, Plymouth, Connecticut, and New Haven—formed the United Colonies of New England, as it was called. They worked to solve boundary disputes and to meet the increased danger of attacks by the Dutch, French, and Indians. Maine, New Hampshire, and Rhode Island were excluded from membership for political and religious reasons.

The four colonies agreed to "enter into a firm and perpetual league of friendship and amity, for offence and defence, mutual advice and succor upon all just occasions, both for preserving and propagating the truth and liberties of the gospel, and for their own mutual safety and welfare."

Two commissioners from each member colony met each year to consider problems that were of mutual interest. The confederation had great power in theory, but, in practice, it could only advise. Under confederation regulations, three colonies comprised a decisive majority. A test of the confederation's power came in 1653, when Plymouth, Connecticut, and New Haven favoured a war against the Dutch of New Netherland. The fourth colony, Massachusetts, did not agree and absolutely refused to yield. This action lessened the prestige of the organization. After 1664, the commissioners met only every three years, and in 1684 the confederation came to an end. Despite serious weaknesses, the confederation provided valuable experience in discussion and cooperation among the colonies. It also helped prevent the smaller colonies from being totally dominated by Massachusetts.

New Forest (pop. 157,000) is a local government district in Hampshire, England, which includes the New Forest itself. In the east, by Southampton Water, is one of Britain's largest oil refineries. Elsewhere, agriculture is important with many smallholdings, especially in the south. Lymington and Ringwood have engineering industries. Lyndhurst is the district's administrative centre.

New Forest is a wooded district in south Hampshire, England. It is bounded by the River Avon and Southampton Water, and covers about 360 square kilometres.

The New Forest consists mainly of forest and heath. It is partly owned by the British Crown, and certain areas are Forest Nature Reserves. The Court of Verderers, a relic of the early administration of the forest, enforces the laws. Ponies and deer roam the forest.

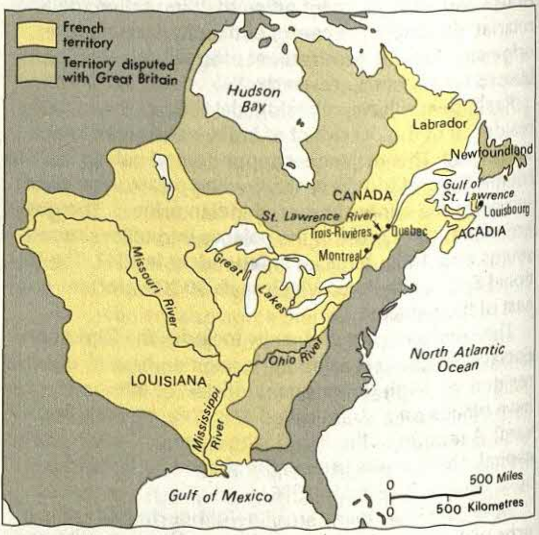
The New Forest was forest before AD 1000, but was made much larger in the reign of William the Conqueror, who hunted deer there. William II, known as William Rufus, was killed in the forest in 1100 while hunting. Timber from the New Forest was used to build ships for the British navy from the 1600's to the 1800's. Today, the New Forest is a popular area for tourists and walkers. Places of interest include Lyndhurst, where there is the Verderers Hall, and Beaulieu which has the ruins of a medieval abbey and a motor museum.

New France was the French colonial empire in North America. The empire began during the early 1600's and lasted about 150 years. At its height in the early 1700's, New France included three colonies—Canada, Acadia, and Louisiana. Canada and Acadia covered much of what is now eastern Canada. Louisiana lay in the Mississippi River Valley of the present-day United States.

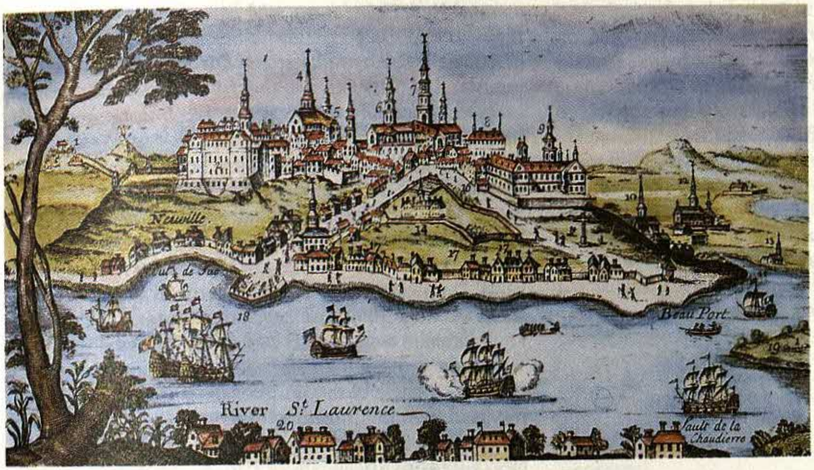
The term *New France* often refers only to the colony of Canada, where about 75 per cent of the empire's settlers lived. France lost this territory to Great Britain in the Seven Years' War (1756-1763). But the French influence on Canadian culture remains strong today. About 6 million Canadians, chiefly in the provinces of Quebec, Ontario, and New Brunswick, speak French. French, along with English, is an official language of Canada.

Exploration and settlement. The first official French expedition to North America occurred in 1524. That year, the Italian navigator Giovanni da Verrazano explored the Atlantic Coast for King Francis I of France. The French explorer Jacques Cartier sailed to Canada in 1534, 1535, and 1541. He became the first European to reach the Gulf of St. Lawrence. Cartier claimed the area surrounding the Gulf of St. Lawrence for France.

During the 1500's, French fishermen began to drop their nets off the coast of what is now Newfoundland.



New France in the early 1700's extended from Labrador to the Gulf of Mexico and included the Mississippi River Valley. The ownership of some areas, such as the region around Hudson Bay, was disputed between France and Great Britain.



The city of Quebec served as the capital of New France. Quebec was also a religious and commercial centre. This engraving from the 1700's shows a view of the city from the St. Lawrence River.

They also started to trade kettles, knives, and other European goods with local Indians for furs. Canadian furs, especially beaver pelts, became increasingly valuable because of the growing popularity of fur hats in Europe.

In 1604, the French explorers Pierre du Gua (or du Guast), Sieur de Monts, and Samuel de Champlain established Acadia along the Atlantic coast. Champlain founded the settlement of Quebec along the St. Lawrence River in 1608. Soon afterward, French fur traders established other settlements on the St. Lawrence River. Roman Catholic missionaries founded Montreal, at first named Ville-Marie, in 1642.

New France grew slowly. It had only a few thousand settlers by 1660. In 1663, King Louis XIV made New France a *royal province,* or colony, of France. Between 1665 and 1672, he sent over about 2,500 settlers. Among them were many women intended as brides for the soldiers and settlers already in the colony.

In 1672, Louis de Buade, Comte de Frontenac, became the governor general of New France. He encouraged fur traders and explorers to help expand the colony. Traders then began to establish a number of posts along the Great Lakes and Hudson Bay. Also, in 1672, the French-Canadian explorer Louis Jolliet and Jacques Marquette, a French missionary, became the first white people to find the upper part of the Mississippi River. The French explorer René-Robert Cavelier, Sieur de La Salle, followed the Mississippi to the Gulf of Mexico in 1682. He claimed the river valley for France and named it Louisiana in honour of Louis XIV.

In 1699, Pierre Le Moyne, Sieur d'Iberville, established the colony of Louisiana. The French then built a chain of forts to link Louisiana with the rest of New France. The population of New France rose from almost 25,000 in 1720 to about 65,000 in 1760.

Colonial life. The chief governing officials of the royal province were the *governor general* and the *intendant.* The governor general supervised the army and relations with the American Indians. The intendant controlled finance, law enforcement, and other local matters. The fur trade was the chief economic activity in New France. Many young colonists were frontiersmen who made their living trading for furs. They were called *coureurs de bois* (vagabonds of the forest). Most coureurs de bois became farmers after they married, and agriculture grew in importance as an economic activity. Farmers reared livestock and grew mostly wheat and oats. Fishing and timber also developed into important industries. In addition, the colony had a brewery, an ironworks, and a shipyard.

By law, all colonists were Roman Catholics, and the Catholic church played a major role in New France. Female religious orders provided hospitals in the towns. They also ran schools.

The towns of Quebec, Montreal, and Trois-Rivières were the centres of trade and culture. Church and government officials and wealthy landowners lived in splendid stone homes in the towns. Merchants and craftworkers had smaller stone houses. Farmers lived on sections of land called *seigneuries.* The king of France granted the seigneuries to nobles, religious groups, military officers, and merchants, who rented the land to farmers. The landowners provided their tenants with a flour mill and a church. Most farmers lived in one- or two-room log cabins.

Both farmers and townspeople in New France often enjoyed dances and other merry social gatherings. Members of the upper class attended grand balls at the residence of the governor general. In winter, the colonists had sleighing parties and held horse races on the frozen rivers.

The British conquest. French and English settlers began fighting for control of the fur trade in the St. Lawrence River Valley in the early 1600's. The English colonies developed along the eastern coast of North America. French expansion during the 1600's angered the English colonists, who also wanted to expand westward.

Members of the two groups and their American Indian allies fought each other in wars from 1689 to 1763. Britain gained Newfoundland, the Nova Scotia region of Acadia, and the French territory around Hudson Bay under the Treaty of Utrecht in 1713. During the next 30 years, the French built forts in the Ohio Valley and across the southern parts of what are now the Canadian provinces of Manitoba, Ontario, and Saskatchewan. Fighting began again in 1744. British colonists captured the French fort at Louisbourg on Cape Breton Island in 1745, but the French regained it in 1748.

The final struggle began in 1754. It is known as the French and Indian War in the United States. The conflict spread to Europe in 1756 and is called the Seven Years' War in Europe. The French were winning until 1758, when British forces captured Louisbourg and several key inland forts. In 1759, the British captured Quebec. The fighting ended when the British took Montreal in September 1760. France gave up Canada and part of Louisiana to Britain in the Treaty of Paris in 1763. France had given the rest of Louisiana to Spain in 1762. France reacquired Louisiana from Spain during the early 1800's and sold it to the United States in 1803.

Related articles in ***World Book*** include:

Acadia
Cartier, Jacques
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Louisiana Purchase
Marquette, Jacques
Quebec, Battle of
Seigneurial system
Seven Years' War

New Guinea is a large tropical island in the Pacific Ocean, north of Australia. It ranks as the second largest island in the world. Only Greenland is larger than New Guinea.

New Guinea has an area of about 818,000 square kilometres and a population of about 6 million. Rugged mountains cover much of the interior of the island. Most of this area has a cool climate. In contrast, the lowlands along the northern and southern coasts are hot and humid.

Most New Guineans live in villages in rural areas. Almost half of the island's people dwell in isolated mountain valleys. Until the 1930's, these New Guineans had little contact with the outside world.

Two political units—Irian Jaya and Papua New Guinea—occupy the island of New Guinea. Both of these units also include nearby islands.

Irian Jaya, formerly called West Irian, covers the western half of New Guinea. It is one of the provinces of Indonesia. Jayapura, a city on the northern coast, serves as the capital of the province. See **Indonesia** (table: The chief islands; New Guinea).

Papua New Guinea occupies the eastern half of New Guinea. Formerly a territory of Australia, it became an independent nation in 1975. Port Moresby, on the southeast coast, is the nation's capital. See **Papua New Guinea.**

Most New Guineans are Melanesians, a Pacific people who have dark skin and black, woolly hair. About 35,000 Asians, Australians, and Europeans also live on the island of New Guinea, most of them in coastal towns. Large numbers of people from other Indonesian islands have settled in Irian Jaya.

In the highlands, most of the villagers live in round thatched huts and grow sweet potatoes as their main food. Pigs provide most of their meat. Many lowland villagers build their houses on stilts to keep them cool and dry. Their chief food crops are bananas, taro roots, and yams. People who live in the swamps of the coastal lowlands eat mostly sago, a starch that is taken from various kinds of palm trees.

There are more than 700 native languages in New Guinea. Because of the number of languages, many people cannot communicate with neighbours who live only a short distance away. A growing number of eastern New Guineans speak Pidgin English, or Tok Pisin, as a second language. This *lingua franca,* or common language, enables speakers of different tongues to communicate with one another. In the west, many people speak Malay as a second language.

A great mountain system crosses New Guinea from east to west. It includes the Owen Stanley Range in the east and 5,030-metre Puncak Jaya, the highest point on the island, in the west. Mountain ridges, grassy plateaus, and deep, forested valleys cover much of the interior. Grasslands and jungles lie along the northern and southern edges of the island. Swamps with mangrove thickets border New Guinea in some areas.

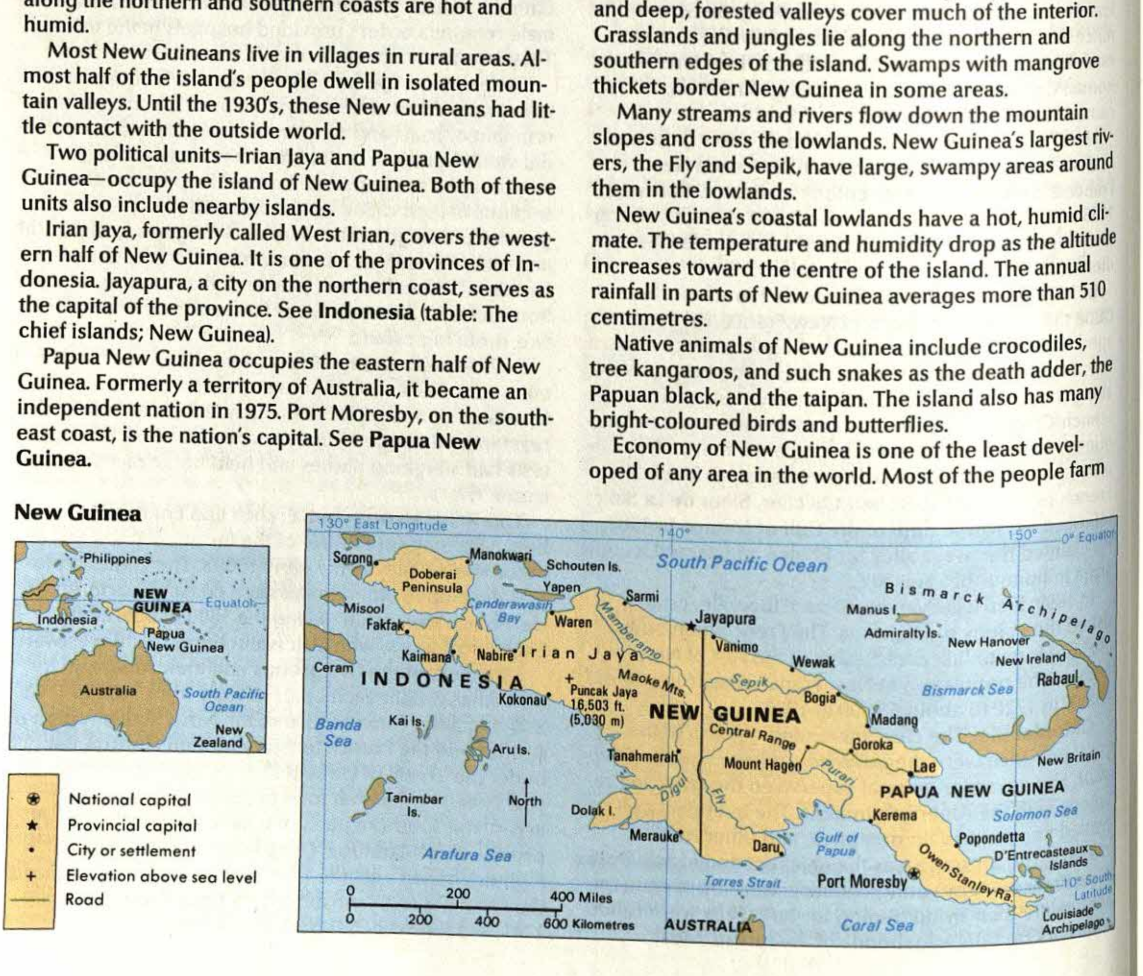
Many streams and rivers flow down the mountain slopes and cross the lowlands. New Guinea's largest rivers, the Fly and Sepik, have large, swampy areas around them in the lowlands.

New Guinea's coastal lowlands have a hot, humid climate. The temperature and humidity drop as the altitude increases toward the centre of the island. The annual rainfall in parts of New Guinea averages more than 510 centimetres.

Native animals of New Guinea include crocodiles, tree kangaroos, and such snakes as the death adder, the Papuan black, and the taipan. The island also has many bright-coloured birds and butterflies.

Economy of New Guinea is one of the least developed of any area in the world. Most of the people farm

New Guinea



the land and grow most of their own food. Many farm people also produce goods that they sell, including coconuts, coffee, and cocoa. A few large plantations also produce cocoa, coconuts, and coffee.

Two large copper mines operate on New Guinea. One is near Nabire in Irian Jaya. Another is in Papua New Guinea, in mountains just east of the Irian Jaya border. These mines also yield small amounts of gold. New Guinea also has oil and natural gas deposits.

The earliest settlers in New Guinea probably migrated thousands of years ago from the Asian mainland by way of the Malay Peninsula and Indonesia. In 1526, Jorge de Meneses, the Portuguese governor of the Molucca Islands, became the first European to visit New Guinea. Dutch, English, French, and Spanish explorers stopped there during the next 300 years. The Netherlands claimed western New Guinea in 1828. In 1884, Germany gained the northeastern part of the island, and Great Britain took the southeastern part. Britain gave its territory to Australia in 1906. After Germany's defeat in World War I (1914-1918), the League of Nations made northeastern New Guinea a mandated territory under Australian rule (see **Mandated territory**).

The Japanese seized northern New Guinea in 1942, during World War II, but by 1944 the Allies had reconquered the area. After the war ended in 1945, the northeastern part became the United Nations Trust Territory of New Guinea under Australian administration. Australia put the northeastern and southeastern units (now Papua New Guinea) under one government in 1949.

Indonesia gained independence from the Netherlands in 1949 and claimed western New Guinea. In 1962, the Netherlands agreed to turn over western New Guinea to the United Nations (UN). The UN placed the area under Indonesian administration in 1963, and Indonesia renamed it West Irian. In 1969, West Irians voted to remain part of Indonesia.

During the 1960's, some New Guineans in both West Irian and Papua New Guinea began demanding independence. In 1969, Indonesia put down an independence movement in West Irian. The province was renamed Irian Jaya in 1973. Australia granted Papua New Guinea total self-government over its internal affairs in 1973. In 1975, Papua New Guinea gained complete independence from Australia.

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Bismarck Archipelago
Bougainville
Clothing (picture: A ceremonial costume)
Echidna
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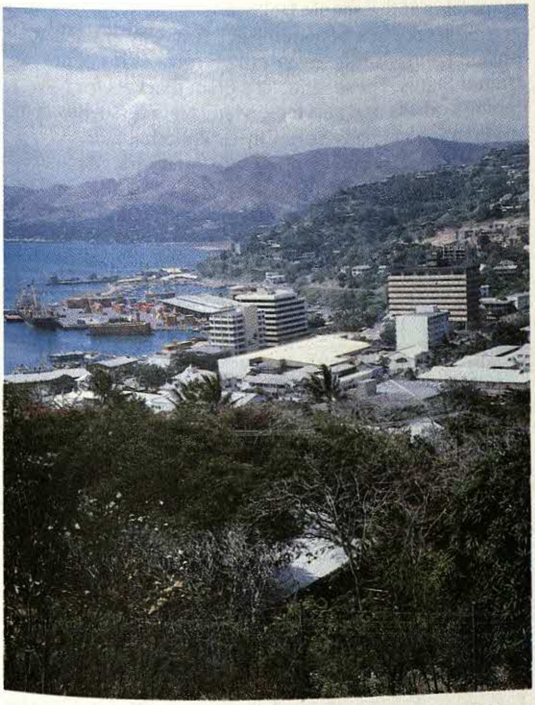
Pacific Islands (with picture: Traditional ways of life)
Papua New Guinea
Port Moresby
Races, Human (picture: The major races [Melanesian])
Sculpture (Pacific Islands)
World War II (The South Pacific)

New Hampshire (pop. 1,113,915) is a state in the northeastern United States. It covers 24,032 square kilometres in the country's New England region and is known for its natural beauty and year-round outdoor activities. Manchester and Nashua are the state's largest cities. Concord is the capital. Large deposits of granite give New Hampshire the nickname the *Granite State.*

The Coastal Lowlands cover the extreme southeastern



Port Moresby, the capital of Papua New Guinea, lies on the southeastern coast of the island of New Guinea. A deep, sheltered harbour helps make the city a commercial centre.

A communications technician, *above,* repairs office equipment in a village in New Guinea. This woman is a Melanesian, the largest population group in New Guinea.

New Hampshire is a popular resort state. The interior includes rich farmland, lush forests, and large lakes.

corner of New Hampshire. Beaches along the state's short coastline are popular recreational areas. Thousands of ducks and geese stop at the region's Great Bay during their annual migrations.

The Eastern New England Upland occupies most of New Hampshire's southern, eastern, and western areas. Rich farmland, forested hills, and large lakes are found in the region's Merrimack Valley, Hills and Lakes area, and Connecticut River Valley. The White Mountains Region covers northern New Hampshire. Mount Washington (1,917 metres), in the region's Presidential Range, is the state's highest peak. The Old Man of the Mountains, a rock formation shaped like an old man's face, is in the Franconia Range.

Much of New Hampshire's economic activity takes place in the southeastern part of the state. That area has most of the state's people and good transportation facilities. Many businesses established operations in southeastern New Hampshire because of the state's low tax rates. Financial companies and electronics manufacturers are especially important. Many tourists visit the region's coastal resorts. In other parts, such traditional industries as wood processing and dairy farming remain important. There are popular ski resorts in the White Mountains.

Algonquian Indians lived in New Hampshire before Europeans went there. Two Englishmen established the region's first permanent European settlements in the 1620's—David Thomson at Odiorne's Point (now part of Rye), and Edward Hilton at Hilton's Point (now Dover). In 1622, John Mason of Hampshire, England, named a tract of land in the region *New Hampshire.*

On June 21, 1788, New Hampshire became the ninth U.S. state when it *ratified* (approved) the U.S. Constitution. Its ratification put the constitution into effect. The state fought on the Union side during the American Civil War (1861-1865).

In 1944, representatives from 44 nations held the International Monetary Conference at Bretton Woods. They made plans to restore world trade after World War II (1939-1945).

New Hebrides Islands. See Vanuatu.

New Holland. In 1642, Abel Tasman, a Dutch navigator, virtually circumnavigated the continent of Australia. Dutch maps produced from his voyage linked Australia, Van Diemen's Land (now Tasmania), and New Guinea as one continent, called *Nova Hollandia* (New Holland).

New Ireland is the second largest island of the Bismarck Archipelago. It covers 8,651 square kilometres in the southwest Pacific (see **Papua New Guinea** [map]). It has about 79,000 people. It is part of the nation of Papua New Guinea. New Ireland is a volcanic island about 370 kilometres long. In its centre rise the Schleinitz Mountains, which are 610 to 1,200 metres high.

New Jersey (pop. 7,748,634) is an important industrial state in the northeastern United States. It lies in the country's Middle Atlantic region, between the Delaware and Hudson rivers. Trenton is the capital of the state. New Jersey's small, quiet towns contrast sharply with its large industrial cities. New Jersey is more densely populated than any other state. Resorts along the state's Atlantic seaboard attract millions of visitors to the state each year.

The Atlantic Coastal Plain covers the southern portion of New Jersey. Beaches, forests, salt marshes, lagoons, and meadows lie in the plain's eastern region. Fertile soil supports market gardens in the south and west.

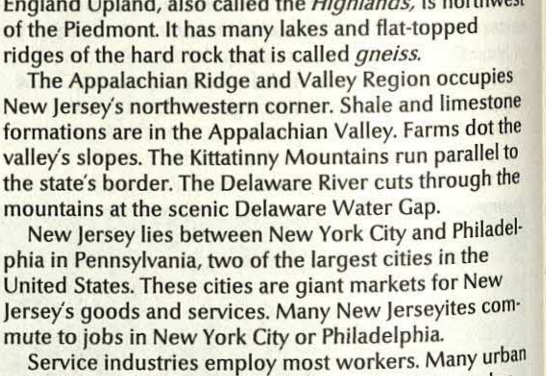
The Piedmont land region lies north of the coastal plain. Such large rivers as the Hudson, Passaic, Ramapo, and Raritan aid the area's large industrial cities. The New England Upland, also called the *Highlands,* is northwest of the Piedmont. It has many lakes and flat-topped ridges of the hard rock that is called *gneiss.*

The Appalachian Ridge and Valley Region occupies New Jersey's northwestern corner. Shale and limestone formations are in the Appalachian Valley. Farms dot the valley's slopes. The Kittatinny Mountains run parallel to the state's border. The Delaware River cuts through the mountains at the scenic Delaware Water Gap.

New Jersey lies between New York City and Philadelphia in Pennsylvania, two of the largest cities in the United States. These cities are giant markets for New Jersey's goods and services. Many New Jerseyites commute to jobs in New York City or Philadelphia.

Service industries employ most workers. Many urban residents work in business services, education, and retail trade. Atlantic City has many hotels and casinos. One of the world's largest private research laboratories, AT&T Bell Laboratories, is near New Providence.

New Jersey manufactures more chemical products



New Jersey, with its long Atlantic coastline, is the United States' most densely populated state.

Workers harvest cranberries from a bog near Chatsworth. New Jersey ranks as a leading cranberry-growing state. Farmers there also produce blueberries, strawberries, and grapes.

A roadside farmstand in Belle Mead sells flowers and farm produce. New Jersey's many market gardens, flower gardens, and orchards earn it the nickname the *Garden State.*

than any other U.S. state. Its other manufactured goods include food products, electrical equipment, and printed materials. New Jersey's leading agricultural products are flowers, milk, and vegetables.

Members of the Delaware tribe of Algonquian Indians lived in New Jersey before Europeans went to the area. Giovanni da Verrazano, an Italian navigator sailing for the French, visited New Jersey's coast in 1524. Henry Hudson, an Englishman sailing for the Dutch, explored Sandy Hook Bay and the Hudson River in 1609. The Dutch established the area's first permanent European settlement in 1660, at Bergen (now part of Jersey City). England won control of New Jersey in 1664. It was named after the island of Jersey in the English Channel.

New Jersey was the site of nearly a hundred battles during the American Revolution (1775-1783). It became known as the *Cockpit of the Revolution.* Princeton and Trenton each served briefly as the U.S. capital during the war. Many New Jerseyites fought in the Union army during the American Civil War (1861-1865), but there was much pro-Southern sympathy in the state.

In the 1800's, improvements in transportation helped make New Jersey a great industrial state. Early industries produced textiles, locomotives, silk, clay products, iron, and steel. Thomas Edison invented the electric incandescent lamp in Menlo Park, New Jersey, in 1879. Electronics and chemical industries began large-scale operations in the state in the 1940's. In 1977, the New Jersey legislature voted to allow gambling casinos in Atlantic City.

The George Washington Bridge spans the Hudson River from Fort Lee to New York City. Thousands of commuters who live in New Jersey and work in New York City use it daily.

New Kingdom of Granada. See **Colombia** (History).

New Left was a radical political and social movement of the 1960's and early 1970's in the United States. The New Left included many college students and other young people. It was "new" in relation to the "old left" of the 1930's. The "old left" generally was guided by Marxist ideas and supported Soviet policies.

Members of the New Left demanded sweeping and fundamental changes in American society. They attacked most major institutions for claiming to support democratic principles but failing to end such injustices as poverty, racial discrimination, and class distinctions. Many New Leftists opposed capitalism and believed the desire for profits leads to *imperialism,* a policy that favours extending influence over another country.

New mathematics is a mathematics teaching programme now used in many countries. The United States introduced it into schools during the 1960's. In the United Kingdom, it is sometimes called "modern mathematics." Most countries, mainly in Europe and Australasia, followed the United States and introduced similar programmes in schools. University mathematicians and government agencies introduced new teaching programmes fairly quickly. Mathematicians wrote new textbooks, and many mathematics teachers underwent training. In the United Kingdom, national projects were set up, such as the Nuffield Mathematics Teaching Project for primary schools and the School Mathematics Project for secondary schools. Local education authorities and the Department of Education arranged in-service courses provided mainly by teachers who experimented with the new curriculum. In addition, the examination boards gradually began to offer alternative examinations for students 16 and 18 years old. By the 1970's, about half of United Kingdom secondary schools followed the new mathematics syllabuses.

The main change in the teaching programme was in the choice of topics to be taught. Until the 1960's, mathematics syllabuses had developed little since the 1600's. Topics and techniques were not those used currently in industry and commerce. Some mathematicians believed that the whole basis of school mathematics was somewhat illogical. New mathematics emphasized modern topics currently used in science, technology, and the economical sciences, such as vectors and matrices, probability, and linear programming. Students used calculators in the study of numerical methods. Schools developed the study of sets to provide a sounder logical basis for the rest of mathematics (see **Set theory**). They also included new topics in algebra, such as Boolean algebra and group theory (see **Boolean algebra**).

Educationalists had recognized for a long time that the methods of Euclid, still in use in most schools, were outdated and even illogical. Tutors now approached geometry through the study of sets, or as transformation geometry. This form of geometry is the study of such transformations as reflection, rotation, enlargement, and symmetry.

Research into the learning of mathematics, especially that of the Swiss psychologist Jean Piaget, influenced the teaching and choice of subjects. For example, Piaget's researches found that children pass through a stage in which they understand the way things are connected, but not distances, directions or shape. This led to the introduction of topology, a branch of mathematics popularly known as "rubber-sheet" geometry (see **Topology**).

The reform towards the new mathematics declined around the end of the 1970's. Criticism came from the parents who did not understand the new topics taught to their children. Resistance also came from employers, whose entrance examinations did not match the new syllabuses. In addition, they perceived an apparent drop in educational standards and blamed it on the changes. Criticism came also from educational circles. In countries where the material had been provided by mathematicians, the new texts were found to be not suitable for teaching. Schoolchildren, and sometimes teachers, often could not understand the materials or the importance of the chosen topics. Often teaching happened in the same drill-and-practice way that the reforms were trying to remove.

Even in the United Kingdom, many teachers believed the reforms to be too rapid and had difficulty in coping. Generally, many of the improvements in teaching styles remained. But the syllabuses reverted largely to topics taught before the reforms.

New Mexico (pop. 1,521,779) is a state in the southwestern United States. It is called the *Land of Enchantment* because of its scenic beauty and rich history. Spain once ruled New Mexico, and the Spanish influence shows strongly in place names, foods, and holiday customs.

New Mexico is large in area, but one of the smallest states in population. Albuquerque is its largest city and chief centre of industry, transportation, and trade. Santa Fe is the second largest city and state capital.

Plains cover roughly the eastern third of the state. The lowest elevation in New Mexico, 859 metres, occurs within those plains at Red Bluff Reservoir, along the state's southern border. The Rocky Mountains rise in north-central New Mexico. Wheeler Peak, 4,011 metres, is the highest point in the state.

Northwestern New Mexico contains valleys and plains, canyons, cliffs, and *mesas* (flat-topped hills). The southwestern and central region of the state includes scattered ranges of rugged mountains.

New Mexico has a dry, warm climate. Temperatures average 23° C in July, and 1° C in January.

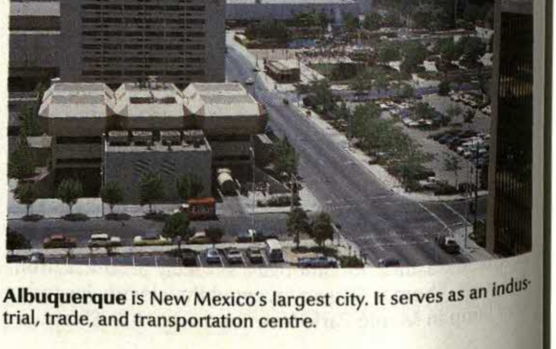
Government ranks as the single most important economic activity in New Mexico. U.S. government research laboratories for nuclear energy are leading employers. Other service industries receive much income from tourists, who are attracted by New Mexico's scenic beauty and its cultural heritage.

Large petroleum and natural gas reserves make New Mexico an important mining state. Natural gas and petroleum each account for about 40 per cent of the state's total income from mineral products. Natural gas is produced in the northwestern and southeastern parts of the state. Much of New Mexico's gas is sent by pipeline to other states. About three-fourths of New Mexico's petroleum comes from Lea County in the southeastern corner of the state.

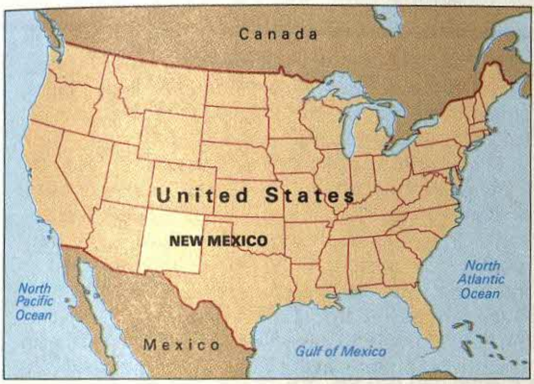
Petroleum refining is the most important manufacturing activity in New Mexico. The production of electronic equipment ranks as the second most important manufacturing activity. Nearly all of this industry's production comes from the Albuquerque area. Food processing is the third most valuable manufacturing industry.

The most important agricultural activity is ranching. The state has about $1\frac{1}{2}$ times as many cattle and sheep together as it has people. New Mexico's leading farm products, in order of importance, are beef, cattle, hay, and milk. Most of the production comes from the eastern part of the state. Other important farm products include chili peppers, maize, cotton, sorghum grain, and wheat.

Indians have probably lived in what is now New Mexico for about 20,000 years. Spanish explorers of the 1500's were the first white people to enter the re-



Albuquerque is New Mexico's largest city. It serves as an industrial, trade, and transportation centre.



New Mexico borders on Mexico to the south. Neighbouring U.S. states are Arizona, Colorado, Oklahoma, and Texas.

gion. Spain ruled the region until 1821, when New Mexico became a province of Mexico. That same year, the Santa Fe trail opened, linking New Mexico with the state of Missouri. The United States took possession of New Mexico in 1848. It became a state on Jan. 6, 1912.

The world's first atomic bomb was exploded at Trinity Site, near Alamogordo, on July 16, 1945. The bomb was produced at Los Alamos, a town and laboratory built secretly in the mountains. New Mexico ranks as a leading centre of space and nuclear research.

New Netherland was a region in America claimed by the Dutch in the early 1600's. It included parts of what are now the states of Connecticut, Delaware, New Jersey, and New York.

In 1621, merchants in the Netherlands formed the Dutch West India Company to compete with the Spanish Empire, colonize New Netherland, and develop the region's fur trade. Thirty families, sponsored by the trading company, began a Dutch colony at the mouth of the Hudson River in 1624. In 1625, the Dutch settlers founded New Amsterdam (now New York City) there. Peter Minuit, the governor of the settlement, bought Manhattan Island from the Indians in 1626. The Dutch set up trading posts at what are now Albany, New York; Hartford, Connecticut; and Trenton, New Jersey.

The company attracted settlers from many European countries. About 20 languages were spoken in the colony, and many religions were represented. The Dutch became allies of the Iroquois Indians and fought other tribes and neighbouring French colonists.

By the 1650's, a fierce trading rivalry had built up between the Dutch and the English. In 1664, the English sent a fleet of warships to capture New Netherland for the Duke of York. Many Dutch colonists refused to fight, and Governor Peter Stuyvesant was forced to surrender to the English. New Netherland became the English colony of New York.

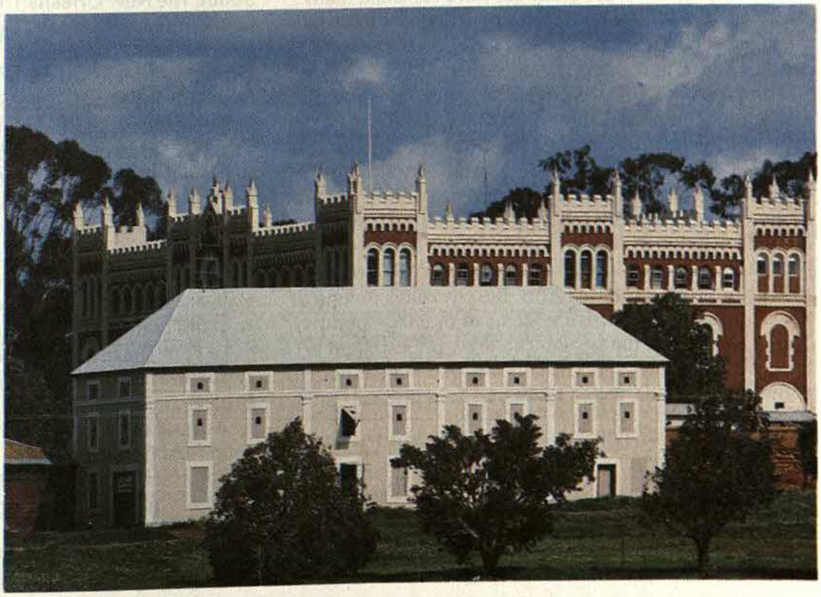
See also **Dutch West India Company; New York** (History); **Stuyvesant, Peter.**

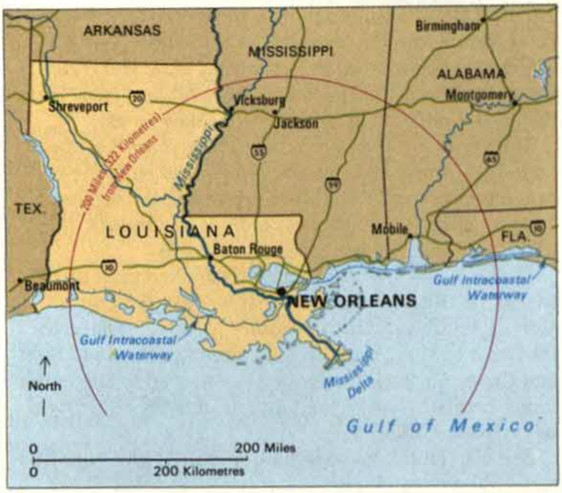
New Norcia is a monastic town on the Moore River about 130 kilometres north of Perth, Australia. It includes a hotel, a shop, an inn, a museum and an art gallery. The monastery was established in 1846 by Benedictine monks from Spain who came to work with Aborigines in the area. Today, about 25 members of the Benedictine community live in New Norcia. In addition to their monastic activities, they operate a wheat and sheep farm, provide a guest house, and care for the local parish. About 150 students attend New Norcia Catholic College, a coeducational boarding school.

New Orleans (pop. 496,938) is the largest city in Louisiana and one of the world's busiest ports. It is also a leading business, cultural, and industrial centre of the Southern United States. New Orleans lies along the Mississippi River about 160 kilometres north of where the river flows into the Gulf of Mexico. This location has helped to make the city a great shipping centre.

Many people call New Orleans *America's Most Interesting City.* Each year, several million tourists visit New

New Norcia is a monastery that lies 129 kilometres north of Perth. It was established in 1847 by Benedictine monks from Spain. A flour mill and a school for local Aboriginal children are among the buildings of the monastery.





New Orleans lies in southeastern Louisiana.

Orleans. The largest crowds come for the annual Mardi Gras celebration, with its spectacular parades and other merry festivities. Tourists are also attracted by the city's historic French Quarter, much of which has the charm of an old European town. In addition, many visitors come to New Orleans to hear top jazz musicians perform in the city that helped give birth to jazz in the early 1900's.

New Orleans is the oldest major city in the South. It was founded in 1718 by Jean Baptiste le Moyne, Sieur de Bienville. Bienville was the governor of the French colony of Louisiana. He named New Orleans after Philippe, Duke of Orléans, who ruled France for King Louis XV, then a youth. The flags of France, Spain, the Confederate States, and the United States have flown over the city.

Today, New Orleans is a colourful blend of old and new. Most of the historic sites have been preserved, while urban renewal programmes have replaced many decaying structures with striking new buildings. But like many other large U.S. cities, New Orleans faces such problems as crime, poverty, and slums.

The city. New Orleans covers 943 square kilometres, including 427 square kilometres of inland water.

New Orleans is often called the *Crescent City* because its original section—the French Quarter—lay along a giant curve in the Mississippi River. Today, the main part of the city lies between the river on the south and Lake Pontchartrain on the north. Much of New Orleans is below sea level and lacks natural drainage. To prevent floods during heavy rainstorms, the city relies on one of the world's most extensive systems of drainage pumps. The 112 pumps in the system can draw off 95 billion litres of water a day. New Orleans has also built about 209 kilometres of walls, called *levees,* to help prevent floods.

Central New Orleans includes the French Quarter and the main business district. The French Quarter was named after the French colonists who first settled the area. It is also called the *Vieux Carré* (pronounced *vee yoo cair RAY*), meaning *Old Square.* Most buildings in the French Quarter, however, look more Spanish than French. Terrible fires swept through the area in 1788 and 1794. At that time, Spain ruled Louisiana, and so the rebuilding favoured the Spanish style of architecture. This style can be seen in many homes and other buildings with their lovely, landscaped patios and graceful balconies of lacy iron grillwork.

The people. Blacks make up 62 per cent of New Orleans' population. Whites and a small number of Asians account for most of the rest of the population. Many white Orleanians are descendants of European immigrants who came to the city to find opportunity and freedom during the 1800's and early 1900's. Many other Orleanians arrived from Latin-American countries during the 1900's. Blacks have lived in the city since the first slaves were brought in the early 1700's.

The black slaves worked on farms and plantations in and near the city. New Orleans also had many free blacks, who came from the West Indies. In the early 1900's, black musicians made New Orleans a world-famous centre of jazz. Black jazz bands still follow a New Orleans custom and play in black funeral processions to and from cemeteries. See **Jazz.**

Today, about 308,000 blacks live in New Orleans and form the city's largest ethnic group. Many are poor and live in mainly black communities near the city centre. Other groups of Orleanians include those of Cuban, French, German, Irish, Italian, Mexican, Polish, or Vietnamese ancestry. Many of the city's residents who came from Latin America live southeast of the city centre.

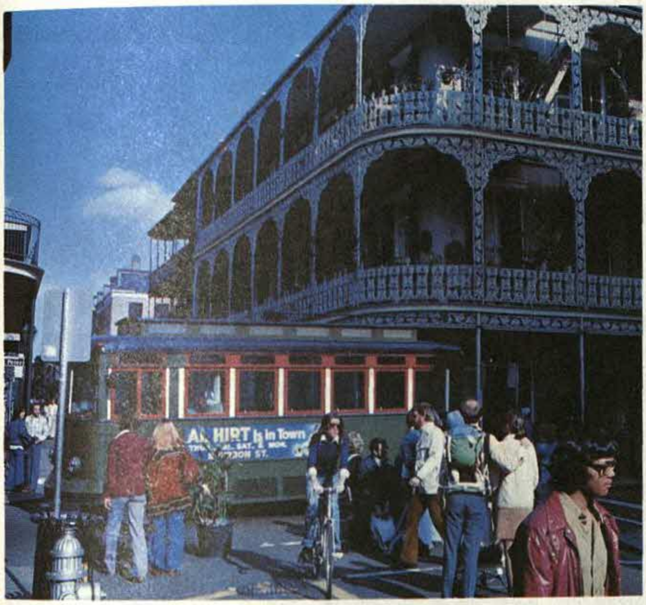
The descendants of New Orleans' early French and Spanish residents are known as *Creoles.* The term *Creole* comes from the Spanish word *criollo,* which means *native to the place.* The Creole influence is still strong in New Orleans. For example, on All Saints' Day (November 1), a citywide holiday that honours the dead, many Orleanians follow the Creole tradition of going to the cemetery in family groups. Creole cooking, a spicy blend of French and Spanish dishes, remains popular in restaurants throughout New Orleans.

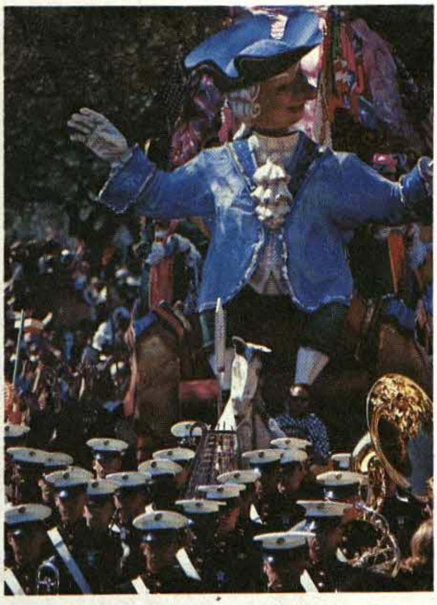
Arts. New Orleans is a leading cultural centre of the South. The New Orleans Theater of the Performing Arts houses the New Orleans Opera House Association. The New Orleans Philharmonic Symphony performs in the Orpheum Theater. Another popular organization is the New Orleans Summer Pops orchestra.

New Orleans has been known for its jazz ever since the city helped give birth to the music in the early 1900's. Black and a number of white musicians helped to develop jazz in the bars and nightclubs on Basin, Rampart, and other streets in the French Quarter. Today, old New Orleans-style jazz can still be heard in many places in the city. One of the most famous places is Preservation Hall, a small building where fans sit on wooden benches or stand to hear jazz concerts.

Le Petit Théâtre du Vieux Carré is one of the city's best-known professional theatre companies. The Dashiki Project Theatre is an outstanding black company.

Annual events. Every year, about a million visitors attend New Orleans' exciting Mardi Gras festival in February or March. The celebration climaxes the city's carnival season, which begins in January. Mardi Gras activity lasts about two weeks and ends on Shrove Tuesday, the day before the Christian observance of Lent starts. It features joyful parades and elaborate costume balls spon-





New Orleans' famous attractions include its historic French Quarter, *left,* and colourful Mardi Gras parades, *right.* The lacy iron grillwork that decorates many French Quarter buildings is a trademark of the city. The spectacular Mardi Gras festivities end the day before Lent begins.

sored by private carnival organizations known as *krewes.* On Shrove Tuesday, also called Mardi Gras Day, the king of the Rex krewe leads a merry parade of several hundred floats. Brightly costumed riders on the floats toss beads, toys, and imitation gold coins called *doubloons* to eager crowds.

Another popular annual event in New Orleans is the Jazz and Heritage Festival. Every New Year's Day, New Orleans hosts the famous Sugar Bowl football game. The game, held in the Superdome, features two of the nation's top college football teams.

Social problems. The chief social problems in New Orleans, as in most other large U.S. cities, include poverty, slums, and crime. Most of the needy have little education and work at low-paying jobs or are unemployed. Deteriorating housing in low-income areas is a serious problem in New Orleans. Many of the poor are forced to live in overcrowded, run-down housing.

Economy. New Orleans' economy depends heavily on shipping and tourism. The Port of New Orleans ranks among the world's busiest seaports. The French Quarter helps attract more than 700 conventions to New Orleans yearly. In addition, the city is one of the South's major centres of business, industry, and transportation.

The Port of New Orleans handles about 132 million metric tons of cargo a year. About 5,000 ships from about 60 nations dock at the busy port annually. The chief exports are grain and other foods from the Midwestern United States and petroleum products.

New Orleans is also a busy port for barges. The barges use the nation's two main inland waterways, the Mississippi River and the Gulf Intracoastal Waterway, which meet at New Orleans. The port of New Orleans handles about 50,000 barges yearly.

The New Orleans metropolitan area has about 1,000 manufacturing plants. They employ about 12 per cent of the area's workers and produce more than 1 billion U.S. dollars worth of goods yearly.

The largest industrial complex in New Orleans is the Michoud Assembly Facility, where several companies produce equipment for the United States space programme. Michoud made the Saturn V rocket that launched the Apollo 11 astronauts to the moon in 1969. Other leading industries in the metropolitan area make food products, petrochemicals, petroleum products, and primary metals.

History. Chickasaw, Choctaw, and Natchez Indians lived in what is now the New Orleans area before Europeans arrived. In 1682, the French explorer René-Robert Cavelier, Sieur de La Salle, claimed the entire Mississippi Valley for France.

Sieur de Bienville founded New Orleans in 1718. In 1722, he made it the capital of the French colony of Louisiana, which covered the central third of the present-day United States.

In 1762, King Louis XV of France gave Louisiana to his cousin, King Charles III of Spain. In 1800, France secretly regained the Louisiana region from Spain but did not reveal the fact until March 1803. The next month, France sold Louisiana to the United States.

New Plymouth (pop. 48,519) is a city in the North Island of New Zealand. It is the chief city and port of Taranaki, which was once called *New Plymouth province.* New Plymouth is the base of a vast offshore gasfield development. The city, which lies below the northern slopes of Mount Egmont, has several beaches. Its chief park, Pukekura Park, is one of the most picturesque in New Zealand. The Taranaki Museum and an art gallery are near the city centre. St. Mary's Church, opened in 1846, is one of New Zealand's oldest stone churches.

The Blue Mountains west of Sydney are famous for their rock formations. The formations, *above,* known as *The Three Sisters,* are a popular tourist attraction in New South Wales.

New South Wales

New South Wales is a state in southeastern Australia. It is bounded by Queensland to the north, the Pacific Ocean to the east, Victoria to the south, and South Australia to the west. New South Wales has three main cities—Sydney, Newcastle, and Wollongong. More than half of the people in the state live in Sydney.

The British navigator James Cook sighted the eastern coast of Australia in 1770. He decided to name the area New South Wales because he thought the land looked like southern Wales. But the area that Cook called New South Wales came to be the whole of the eastern half of the continent. New South Wales assumed roughly its present boundaries in 1863.

New South Wales is the richest and one of the most developed of the states of Australia. It is the leading state in agriculture, manufacturing, and mining. Primary production in New South Wales is worth 3,992 million Australian dollars a year, manufacturing 14,060 million Australian dollars, and minerals 3,031 million Australian dollars.

The state flower of New South Wales is the waratah. This shrub has a striking red flower. It grows in the sandstone region around Sydney.

Facts in brief about New South Wales

State capital: Sydney.
Largest cities: Sydney, Newcastle, Wollongong, Wagga Wagga, Maitland, Albury, Tamworth.
Area: 801,600 km²; fourth largest state.
Population: *1991 census*—5,731,926; largest state.
Animal emblem: Platypus.
Bird emblem: Kookaburra.
Floral emblem: Waratah.
Chief products: *Manufacturing and processing*—agricultural implements, chemicals, clothing, fertilizer, glassware, iron and steel, machinery, motorcars, paper, textiles. *Mining*—coal, copper, gems, lead, mineral sands, silver, tin, zinc. *Agriculture*—dairy products, fruit, honey, mutton, poultry, sugar, wheat, wool. *Forestry*—timber. *Fishing*—many types of fish and shellfish.

Like other state governments, the government of New South Wales controls the criminal law, pays its police, and provides law courts. It provides schools, hospitals, and public transport, in parallel with private systems. It also regulates industry and agriculture.

All business is administered through government departments and statutory authorities. Each department and, in varying degrees, each statutory authority is controlled by a *minister* (parliamentary head). The ministers are members of parliament and of state cabinet. The chief minister is called the *premier.*

Each department is administered by a permanent official, who is a member of the public service. This official is responsible to the minister for carrying out government policy decisions. A substantial amount of government business is conducted by statutory bodies or authorities, such as the Electricity Commission and Water Boards.

The executive government decides policy. All members of cabinet become members of the *Executive Council* at the time they are sworn in as ministers of the Crown. The only other member of the Executive Council is the state governor, who represents the Queen. The minimum requirement for an Executive Council meeting is the presence of at least two executive councillors and the governor, which is the usual practice.

The legislature of New South Wales consists of two houses of parliament. The *Legislative Assembly* is the lower house. It has 99 members, elected by the adult population of the state under a system of secret ballot and preferential voting. Elections are held every four years, and voting is compulsory. The Legislative Assembly has full powers of legislation, including the introduction of *money measures* (taxation and government spending). Most of the laws passed by parliament originate in this house.

The *Legislative Council* is the upper house. It acts mainly as a house of review. Its members discuss and review measures that have already been passed through the Legislative Assembly. This house cannot introduce or amend money measures. When *bills* (drafts of proposed laws) have been passed through both houses, they are sent to the governor for signature, which is called the *Royal Assent,* before they become law.

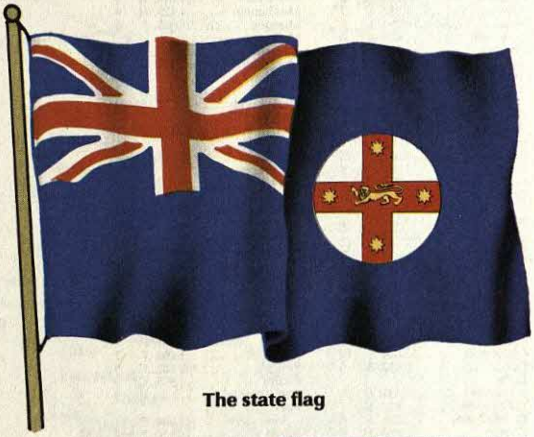
The Legislative Council consists of 42 members, each elected to a term of office equivalent to three terms of the Legislative Assembly. The term of office of 21 members ends at each general election, at which point another 21 members are elected.

Local government. Most of New South Wales is divided into local government areas, called cities, *shires* and *municipalities.* Each shire is divided into smaller areas called *ridings.* Each city and municipality is divided into smaller areas called *wards.*

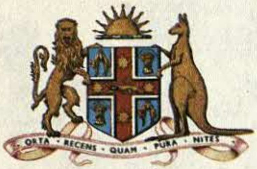
Adult residents elect two or more representatives from their riding or ward for a term of three years. The shire representatives are called *councillors.* City and municipality representatives are called *aldermen.* The chief representatives are known as the *shire president,* the *mayor of the municipality,* or *lord mayor of the city.*

New South Wales has 34 cities, 111 shires, and 31 municipalities operating under the authority of the Local Government Act. Shire councils and municipal councils collect *rates* (taxes) from local property owners.

Symbols of New South Wales. The New South Wales flag dates from 1876. The flag includes a lion on the red cross of St. George, the badge of the old colony of New South Wales. The four stars on the cross represent the Southern Cross. The lion in the centre is from the British arms. The state coat of arms was approved by King Edward VII in 1906. In the centre is a lion on a red cross. The golden fleece symbolizes the wool industry and the wheat sheaf stands for agriculture. The rising sun represents a newly rising country. The supporters are the British lion and the Australian kangaroo. The Latin motto may be translated as *Newly risen, how brightly you shine.* The state floral emblem is the waratah. The state bird emblem is the kookaburra, and the state animal emblem is the platypus.

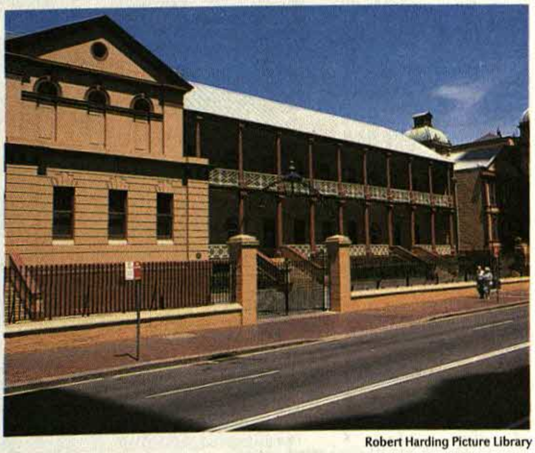


The state flag


ORTA · RECENS · QUAM · PURA · NITES

State coat of arms

Floral emblem
Waratah



Robert Harding Picture Library

New South Wales Parliament House stands in Macquarie Street in Sydney. The government first occupied it in 1829.

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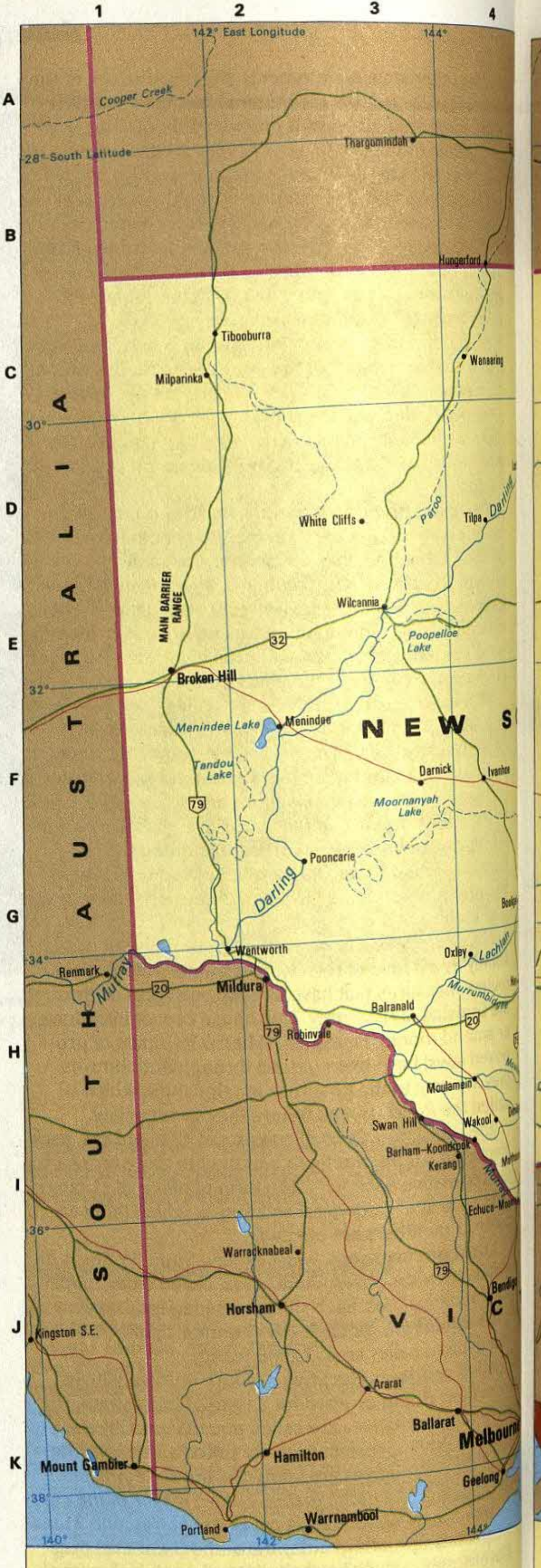
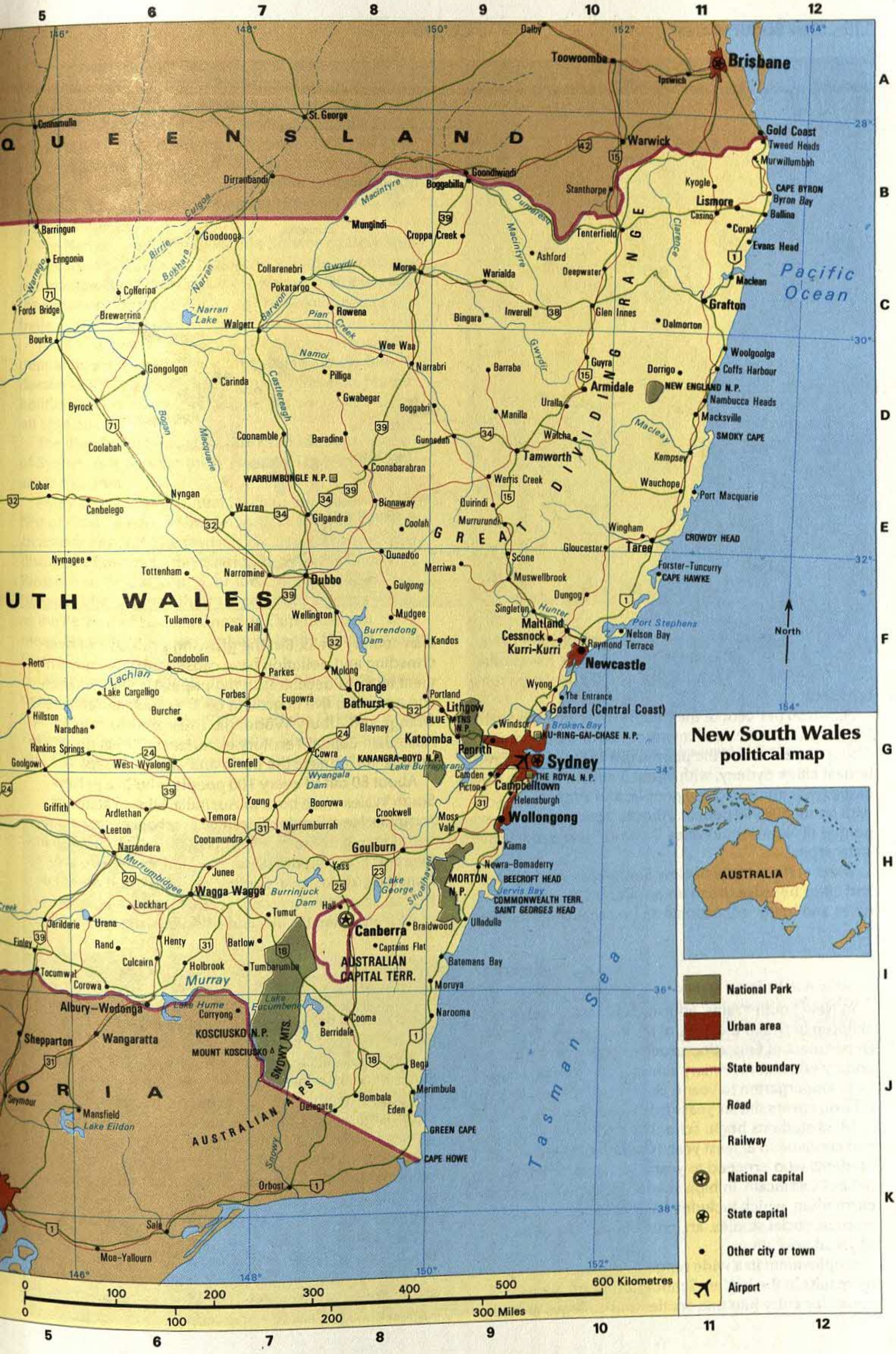
Forster Tuncurry	11,239	E	11
Gilgandra	2,713	E	7
Glen Innes	6,138	C	10
Gloucester	2,397	E	10
Gold Coast-Tweed Heads†	22,280	A	12
Gosford-Woy Woy	162,669	G	10
Goulburn	21,453	H	8
Grafton	17,123	C	11
Grenfell	1,986	G	7
Griffith	20,536	G	5
Gulgong	1,988	E	8
Gundagai*	2,124	H	7
Gunnedah	13,315	D	9
Guyra	1,999	C	10
Hay	3,811	H	4
Helensburgh		G	9
Henty	880	I	6
Hillston	1,052	G	5
Holbrook	1,354	I	6
Huskisson*	2,749	H	9
Inverell	15,590	C	9
Ivanhoe	449	F	4
Jerilderie	954	H	5
Junee	5,221	H	8
Kandos	1,585	F	8
Katoomba [-Wentworth Falls]	15,627	G	9
Kempsey	9,335	D	11
Kiama	15,905	H	9
Kurri Kurri-Weston	13,411	F	10
Kyogle	2,983	B	11
Lake Cargelligo	1,206	F	6
Lawson-Hazelbrook*	7,993	G	9
Leeton	10,802	H	6
Lismore	41,389	B	11
Lithgow	19,815	G	9
Lockhart	910	H	6
Macksville	2,811	D	11
Maclean	2,681	C	11
Maitland	46,733	F	10
Manilla	2,017	D	9
Menindee	406	F	2
Merimbula	3,278	J	8
Merriwa	961	E	9
Mittagong*	4,828	H	9
Molong	1,400	F	8
Moree	16,912	C	8
Morisset*	1,425	F	10
Moruya	2,386	I	8
Moss Vale	4,016	H	9
Moulamein	425	H	4
Mudgee	16,625	F	8
Mullumbimby*	2,453	B	12
Mungindi†	682	B	8
Murrumburrah	2,045	H	7
Murrurundi	878	E	9
Murwillumbah	7,678	B	11
Muswellbrook	15,115	E	9
Nambucca Heads	4,923	D	11
Narooma	2,864	I	8
Narrabri	14,659	D	8
Narrandera	4,835	H	6
Narromine	3,205	E	7
Nelson Bay	9,376	F	10
Newcastle	293,368	F	10
Nowra-Bomaderry	19,553	H	9
Nyngan	2,502	E	6
Oberon*	1,840	G	9
Orange	32,846	F	8
Parkes	13,901	F	7
Peak Hill	1,097	F	7
Penrith	149,682	G	9
Picton	1,975	G	9
Port Kembla*		H	9
Port Macquarie	22,884	E	11
Portland	10,136	F	8
Queanbeyan*	24,943	H	8
Quirindi	2,812	E	9
Raymond Terrace	8,793	F	10
Richmond North*	2,787	G	9
Richmond-Windsor*	17,088	G	9
Sawtell*	7,905	D	11
Scone	4,272	E	9
Shellharbour*	46,297	H	9
Singleton	18,633	F	9
Sydney	3,538,970	G	9
Tamworth	35,068	D	9
Taree	40,513	E	11
Temora	4,295	H	6
Tenterfield	3,370	B	10
Terrigal-Wamberal*		G	10
The Entrance-Terrigal		F	10
Tocumwal	1,273	I	5
Tottenham	368	E	6
Tullamore	319	F	6
Tumbarumba	1,603	I	7
Tumut	11,163	H	7
Ulladulla	7,408	H	9
Uralla	2,250	D	10
Urana	1,604	H	5
Urunga*	2,336	D	11
Wagga Wagga	53,453	H	6
Wakool	249	I	4
Walcha	1,639	D	10
Walgett	2,151	C	7
Wallerawang*	1,988	G	9
Wangi-Rathmines*	6,343	F	10
Warialda	1,335	C	9
Warragamba*		G	9
Warren	3,596	E	7
Wauchope	4,181	E	11
Wee Waa	2,106	C	8
Wellington	9,202	F	8
Wentworth	1,352	G	2
Werris Creek	1,819	E	9
West Wyalong	3,700	G	6
Wilcannia	1,048	E	3
Windsor, see Richmond-Windsor			
Wingham	4,297	E	10
Wollongong	337,524	H	9
Woolgoolga	2,346	C	11
Wyong		F	10
Yamba*	2,880	C	11
Yass	8,780	H	8
Young	10,685	G	7

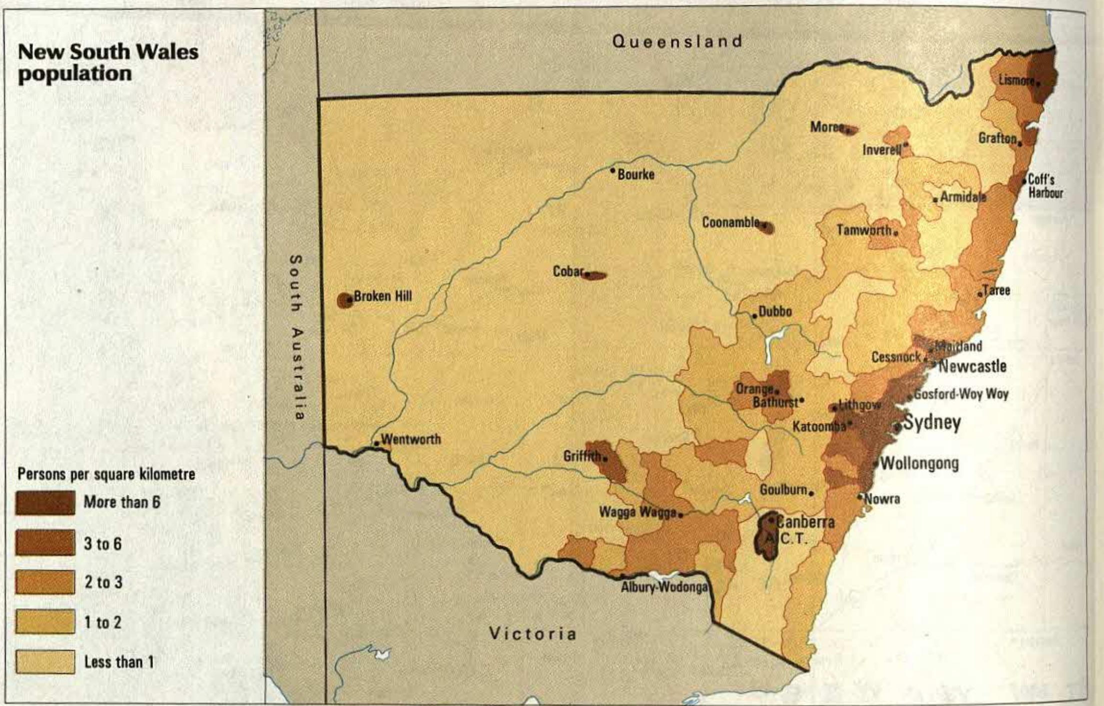
*Does not appear on map; key shows general location.
†City on border of two states; population in New South Wales only.
Source: 1991 census for large cities and towns; 1986 census for smaller places.





New South Wales political map

People



The 1986 census figure placed the population of New South Wales at 5,531,500. On June 30, 1989, it was officially estimated at 5,761,919. Today the population is estimated at 5,401,881.

About 90 per cent of the people of New South Wales live in or near cities and towns of 200 or more people. About 75 per cent of the people live in the state's three largest cities: Sydney, with about 3 million people; Newcastle, with about 255,000 people; and Wollongong, with about 309,000 people. About 60 per cent of the people of New South Wales live in or near Sydney, the state capital.

Most of the people of New South Wales live in towns and cities because urban areas offer more job opportunities and better educational and recreational facilities than country areas. But the growing problems of overcrowding and pollution have caused the state government to try to decentralize the population and encourage people to live in growth centres such as Bathurst-Orange and Albury-Wodonga. The areas close to the Australian Capital Territory experienced great growth in population, as have the north and central coasts.

About 80 out of every 100 people who live in New South Wales were born in Australia. Like all states of Australia, New South Wales has received a large number of immigrants since World War II. Most of these immigrants are from Britain and Ireland. Many also are from Italy, Yugoslavia, Greece, Germany, and other European countries. In recent years, many immigrants arrived from Asian Pacific, and Middle Eastern countries.

Education

In New South Wales, education is compulsory for children between the ages of 6 and 15 years. The state's Department of Education provides free primary and secondary education. Primary school covers seven years—from kindergarten to year 6. Secondary school, or high school, covers the six years from years 7 to 12.

Most students begin school in kindergarten at age 5 and continue to at least year 10, when they are about 16. Students who proceed to year 12 may sit for the Higher School Certificate. In high school, students follow a core curriculum, which includes English, mathematics, science, social studies, art, craft, music, health, and physical education.

Employment in a wide range of professions depends on results in the Higher School Certificate. Requirements for entry into universities and colleges are also largely based on the results students achieve in the Higher School Certificate examinations.

Some students in country districts receive primary and secondary education by correspondence lessons. The state's school of the air uses two-way radios. The state also provides special schools for children with physical, emotional, and mental disabilities. Such schools include hospital schools and community care schools, as well as schools for children who are blind and deaf.

New South Wales has 321 technical colleges as well as the College of External Studies. The state also has 18 institutions of higher education, including 9 universities. Specialized forms of higher education are offered at the state's armed forces training establishments and theological colleges.

Sydney offers many things for tourists to see and do. The Hawkesbury River and Broken Bay are popular tourist areas north of Sydney. Visitors can see many places of historic interest around Parramatta, and in the Richmond-Windsor and Camden area west of the city. Sydney's attractions also include the city's famous opera house and harbour bridge. Many visitors take a ferry to Manly or to Taronga Zoo. Many tourists stay in hotels around Kings Cross.

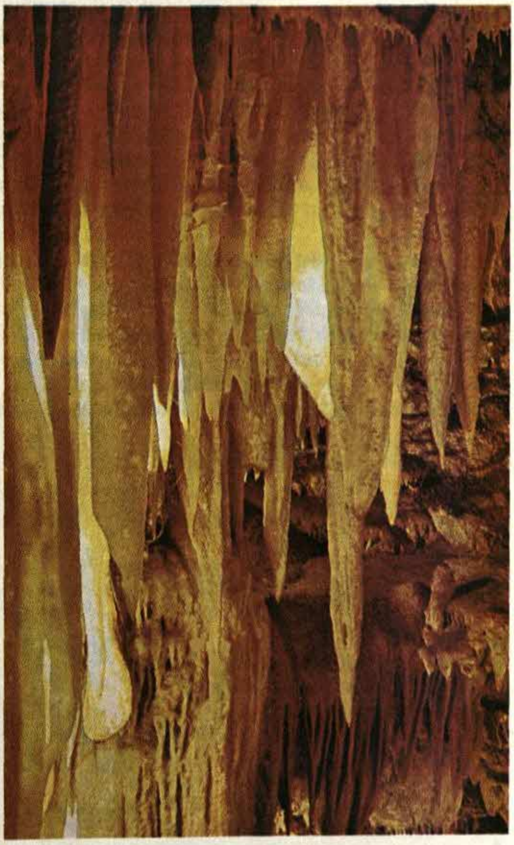
The National Parks and Wildlife Service of New South Wales administers many parks and wildlife sanctuaries. For example, the Warrumbungle National Park is a wildlife sanctuary where tourists can walk along nature trails.

The Kosciusko National Park is a place where many people go skiing and where tourists can go on conducted tours of the Snowy Mountains Scheme. Many holiday-makers enjoy fishing, boating, and water-skiing on Lake Eucumbene.

The Blue Mountains area, 80 to 130 kilometres west of Sydney, is a popular tourist centre. The Jenolan Caves are in this area.

Many centres hold annual festivals and carnivals. The first of these began in Grafton in 1935 and was called the *Jacaranda Festival.* The festivals are usually named after distinctive flowers of the district, such as the Cherry Blossom Festival at Young, or the Tulip Festival in Bowral. Others derive their names from legends, such as the Festival of Fisher's Ghost at Campbelltown. Famous Australians are remembered in the Henry Lawson Festival of Arts in Grenfell.

Other popular festivals include the Blackheath Rhododendron Festival; the Leeton Rice Bowl Festival; the Opal Festival at Lightning Ridge; and the Griffith Vintage Festival. In Sydney, the Royal Easter Show and the Festival of Sydney attract thousands of spectators each year.



Oriental Cave in the Jenolan Caves west of Sydney

Mount Kosciusko, Australia's highest peak, rises 2,228 metres above sea level in the Australian Alps, in southern New South Wales.

Land

Location and size. New South Wales lies in the southeastern corner of the Australian continent. The state stretches 1,099 kilometres along the Tasman Sea, from Point Danger in the north to Cape Howe in the south.

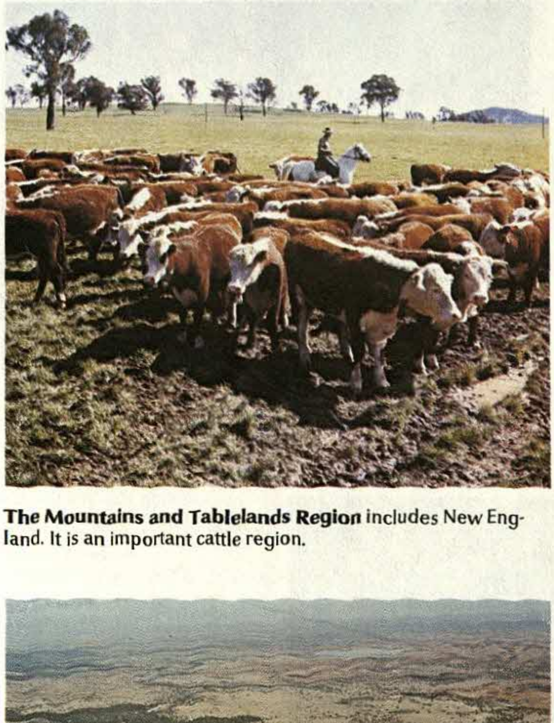
The total length of the coastline is 1,900 kilometres. The state is 1,370 kilometres wide at its widest point and covers an area of 801,600 square kilometres. New South Wales occupies about 10 per cent of the total land area of Australia.

Land regions. Most people in New South Wales live in the *Coastal Belt.* The *Mountains and Tablelands Region,* the *Slopes and Plains Region,* the *Murray Basin Slopes,* and the *Riverina* are important farming areas. *The Lower Darling Basin* is a dry area in the west of the state. The *Darling Downs* and the *Channel Country* regions extend from Queensland into western New South Wales. The western fringe of the state can be classified as part of the *Central Desert Area.*

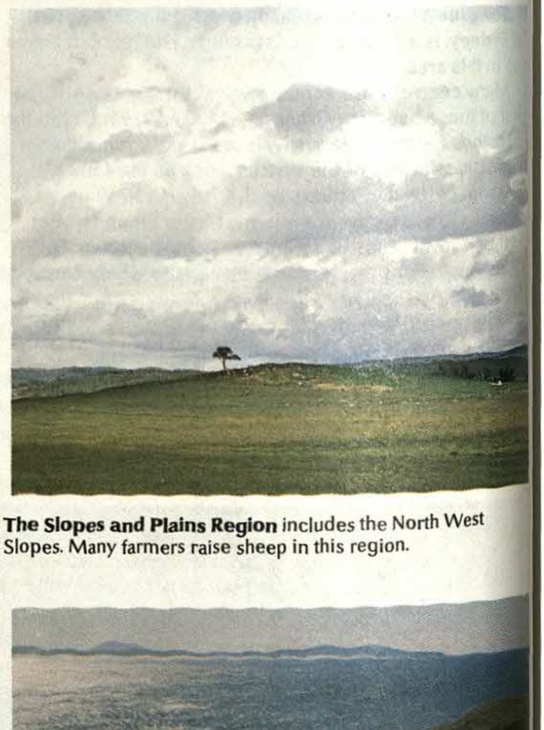
The Coastal Belt includes the North Coast. This narrow strip of land, between Taree and the Queensland border, is crossed by a number of large rivers. It is mainly a farming area with large dairy and beef cattle farms. Forestry, sugar cane, and tropical fruit production are also important. To the south lies the Hunter Valley, an area of fertile land that lies on both sides of the Hunter River. Many dairy farms are located in this area. Beef cattle are raised along the hills and ridges at the edges of the valley.

The Hunter Valley is well known for cultivation of grapes and its production of fine red and white table wines. Vegetables are grown around Maitland. The Hunter Valley is also an important coal-mining area.

The Sydney Region is situated on the coastal belt and



The Mountains and Tablelands Region includes New England. It is an important cattle region.



The Slopes and Plains Region includes the North West Slopes. Many farmers raise sheep in this region.

The Darling River flows through western New South Wales. Much of the land in this area is arid.

The Coastal Belt includes holiday resorts like Crescent Head, *above,* near Kempsey, on the narrow North Coast area.

is bordered on the north by the Hunter Valley and on the south by the South Coast. The western boundary is the scarp of the Blue Mountains. The South Coast extends south from Sydney to the Victorian border. Most of this region is devoted to dairy farms, or to forests, which are grown for timber.

The Mountains and Tablelands Region extends from the McPherson Range in the north to the Snowy Mountains in the south. This region includes New England, which is the largest highland area in the state. The tablelands stretch north to the Queensland border from an area south of Tamworth.

Vegetation in the region varies greatly, from the wooded hill country, where forestry is important, to the rich soil of the cultivated valleys. Farmers in the tablelands region engage in mixed farming. They also raise sheep and cattle and grow fruit.

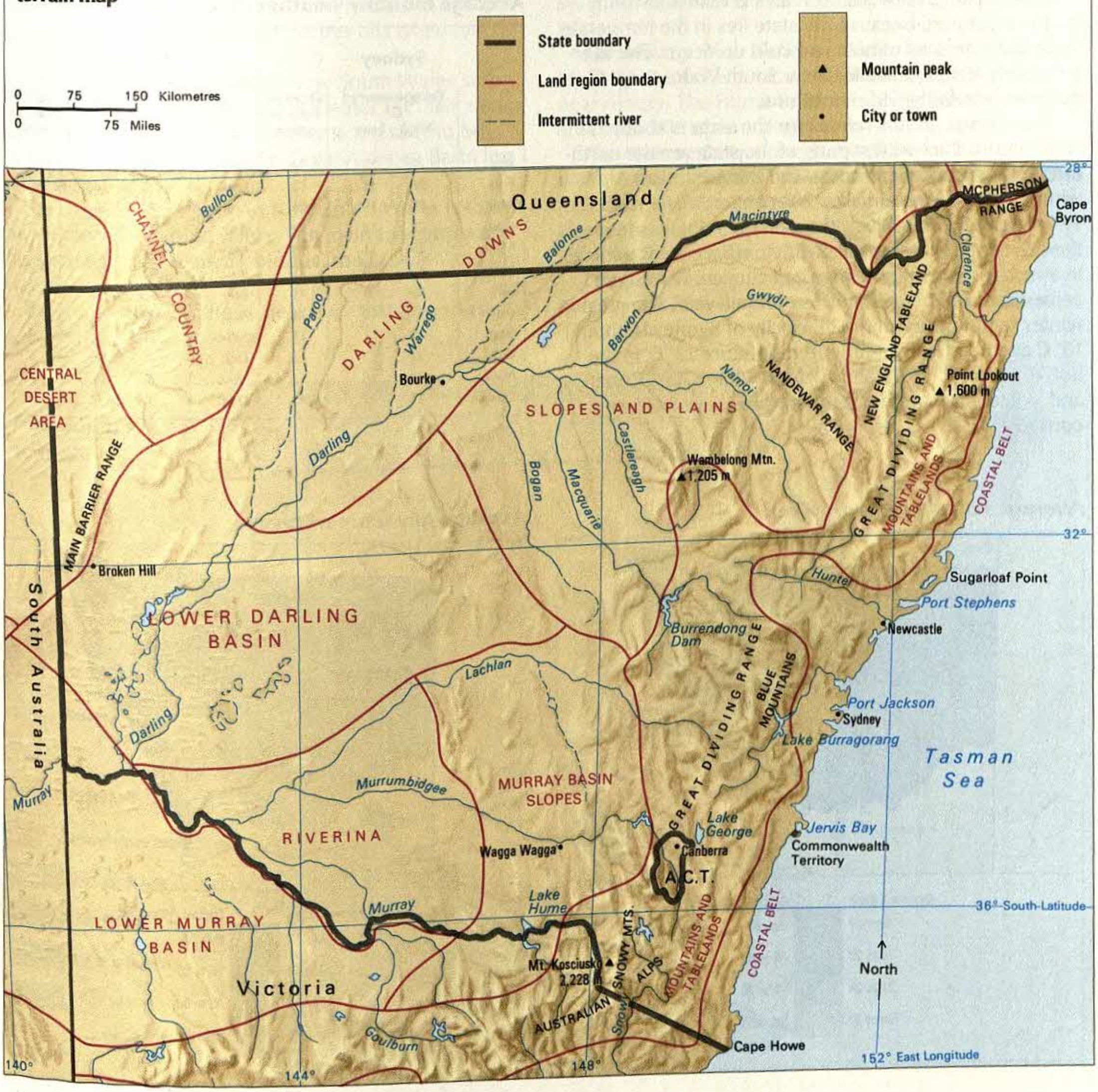
The region's Central Uplands consist of a raised plateau of the Great Dividing Range. This area includes hill country and open river plains. Farms in this area produce much wool and also grow such crops as wheat and oats. Around Orange, where there are rich, red, volcanic soils, much fruit is produced.

The Southern Tablelands is an upland area that includes Canberra and the Australian Capital Territory. It extends south from around Mittagong to the eastern side of the Snowy Mountains.

The Australian Alps is an area of broad uplands and mountain peaks in southern New South Wales. In this region, Australia's highest peak, Mount Kosciusko, rises 2,228 metres above sea level. The Murray River rises close to Mount Kosciusko.

The Slopes and Plains Region includes the North West Slopes. This area stretches from Goondiwindi on

New South Wales
terrain map



the Queensland border south to the area around Dubbo and Wellington. It is bounded to the east by the western side of the Liverpool Range. It includes the volcanic region of the Warrumbungle and the Nandewar Range.

The Lower Darling Basin area comprises the arid plains bordering the Darling River between Wilcannia in the north and Wentworth in the south.

The Murray Basin Slopes are the southern part of the sheep and wheat areas of the southeast. The slopes stretch from Dubbo on the Macquarie River in the north to Albury on the Murray River in the south.

The Riverina is a flat area that forms part of the Murray Basin. The Murrumbidgee Irrigation Scheme and the Coleambally Irrigation Scheme supply water for fruit growing and for crop and animal farming. The area around Griffith is known for growing rice and vegetables and for the production of wine.

Climate

The climate of New South Wales is mild and sunny for the most part, because the state lies in the temperate zone. But extremes of heat and cold do occur. The average yearly temperature for New South Wales is 16° C. But there are fairly wide variations.

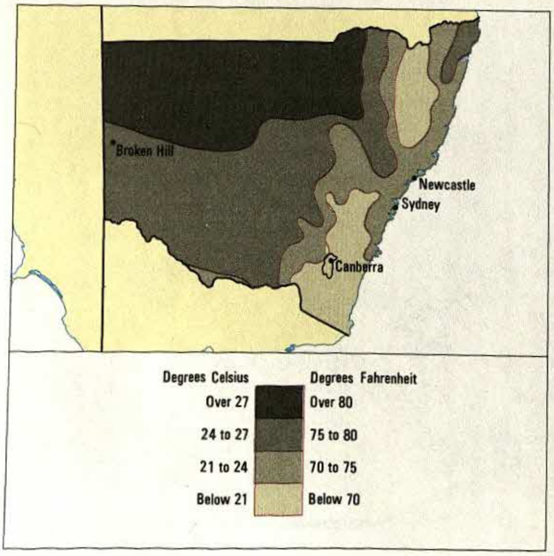
The average annual rainfall for the state is about 71 centimetres. The wettest parts of the state are the northern coast, the southern coast, and the Australian Alps, where the average rainfall is 203 centimetres a year. West of the Darling River, the average rainfall is less than 25 centimetres a year. Sydney, where most people in the state live, enjoys a pleasant climate. The city receives about 1,220 millimetres of rain a year. The mean winter temperature of the inner city of Sydney is about 13° C and the mean summer temperature 22° C. In the hot, dry areas of the state, such as White Cliffs, Cobar, and Wilcannia, summer temperatures have been recorded at 40° C.

The climate of New South Wales is mild and sunny. Many people go water-skiing on Tuggerah Lakes during the summer.

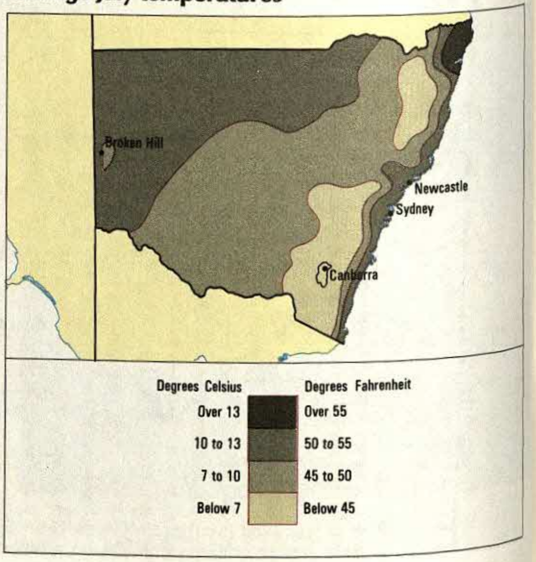
Average monthly weather

	Sydney				**Broken Hill**		
	Temperatures C°		**Days of rain or snow**		**Temperatures C°**		**Days of rain or snow**
	High	**Low**			**High**	**Low**	
Jan.	26	18	13	Jan.	32	19	3
Feb.	26	18	13	Feb.	32	18	3
Mar.	24	17	14	Mar.	28	16	3
Apr.	22	14	13	Apr.	24	12	3
May	19	11	13	May	19	9	4
June	17	9	12	June	16	6	5
July	16	8	11	July	15	5	5
Aug.	17	9	11	Aug.	17	6	5
Sept.	19	11	11	Sept.	20	8	4
Oct.	22	13	12	Oct.	25	12	4
Nov.	23	16	12	Nov.	28	15	3
Dec.	25	17	12	Dec.	30	6	3

Average January temperatures



Average July temperatures



Natural resources of New South Wales are closely linked with its climate, soils, and vegetation.

The soils may be divided into three groups. *Humid soils* are found in the coastal and some tableland areas. Humid soils include the rich alluvial soils of the river valleys and the red loams of the higher ground. *Subhumid soils* are found in the great wheat- and cotton-growing areas, such as the Liverpool Ranges and areas to the north. *Semiarid soils* are found in much of the interior. They can either be brown, light soils in the summer rainfall areas of the northern part of the state, or the heavier brown and grey soils found in the south, including the Riverina area. In the far western districts, much of the soil is extremely poor.

Water in New South Wales, as in the rest of Australia, is not abundant because of the low average rainfall. As a result, New South Wales has few lakes. The Blue Lake and Lake May are in the Australian Alps. Lake George, the largest freshwater lake in New South Wales, is near Canberra.

Many lakes in the interior dry up during droughts. These lakes fill when the rivers flood in the wet season. For example, Lake Cowall near Forbes fills when the Lachlan River floods.

Farmers in the drier parts of New South Wales sink artesian bores to tap underground water for their sheep and cattle. This underground water is too salty to be useful for irrigation. Part of the Great Artesian Basin lies in the state.

The largest river system in New South Wales is that of the Murray and Darling rivers. The main tributaries of this system are the Murrumbidgee, the Lachlan, and the Macquarie.

The Hunter River is the largest river that flows eastward to the sea on the New South Wales coast. It is 462 kilometres long. Other important coastal rivers are the Tweed, the Richmond, the Clarence, the Macleay, the Manning, the Hawkesbury, and the Shoalhaven.

Minerals. Large supplies of black coal are found in the Hunter Valley, round Greater Wollongong and Lithgow. New South Wales also has good supplies of other minerals, including silver, lead, zinc, limestone, rutile, copper, and such gemstones as opals and sapphires.

Forests cover about 19 per cent of the area of the state. There is increasing controversy over continued logging and woodchip extraction in these areas.

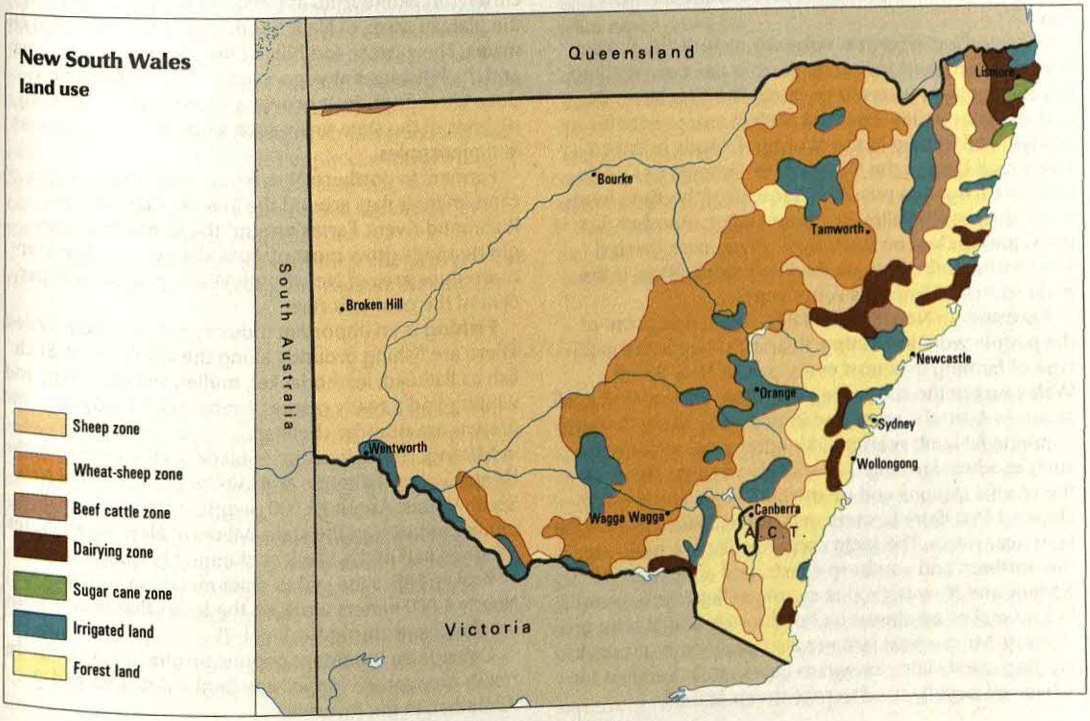
Power and irrigation schemes. Rainfall is low and unreliable in a wide area of the state. For this reason, water conservation is extremely important. The Snowy Mountains Hydro-Electric Authority controls a huge hydroelectric and irrigation scheme. The State Water Resources Commission has built large dams in many areas.

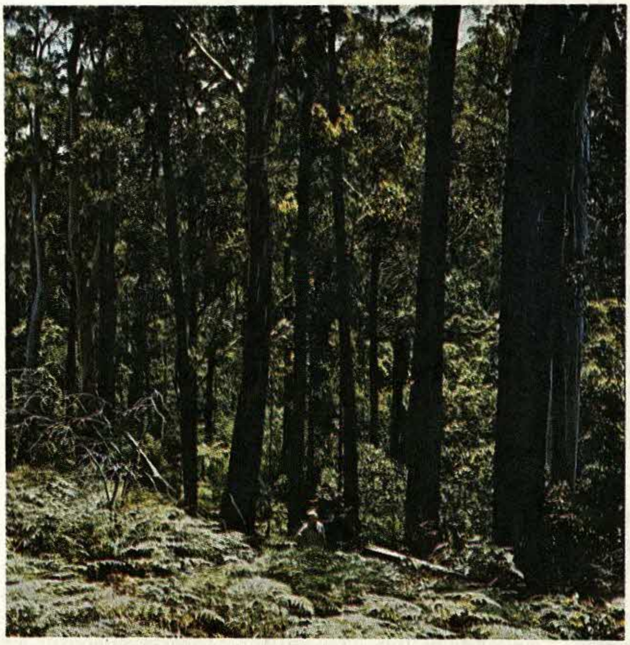
The Snowy Mountains Scheme combines a huge hydroelectric scheme with an irrigation project. The basic purpose of this scheme is to transfer to the inland river system waters that would normally flow unused to the sea.

The Murray River Scheme. Water for the Murray Valley Irrigation Scheme is stored in the Hume Reservoir, near Albury. The Hume Reservoir collects water from an area of 16,000 square kilometres.

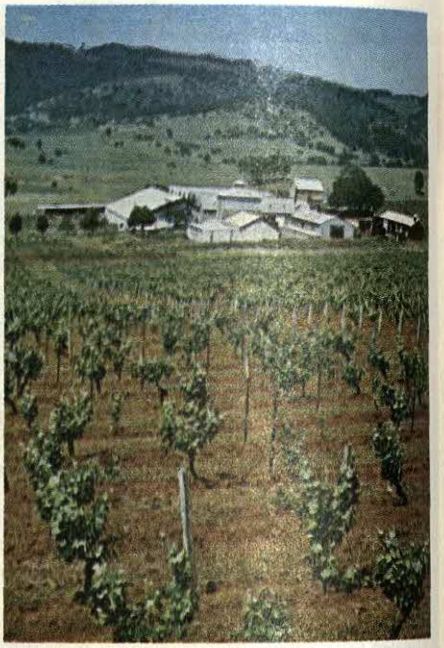
The Murrumbidgee Irrigation Scheme has as its main storages Blowering Dam, near Tumut, and Burrinjuck Dam, near Yass. Water stored in the Blowering Dam comes from the Tumut River and water released from the Snowy Mountains Scheme.

The Coleambally Irrigation Scheme is a scheme in the Riverina. The Gogeldrie Weir, near Narrandera, di-





State hardwood forests, such as the one near Eden, produce valuable timber. Hardwoods include many eucalypts.



Vineyards, such as the ones at Pokolbin in the Hunter Valley, produce especially fine wines.

verts water from the Murrumbidgee River to be used for intensive cultivation in this area.

The Lachlan River Irrigation System has the Wyangala Dam, upstream from Cowra, as its chief storage dam. Storage dams at Lake Cargelligo and Lake Brewster conserve water during flooding of the Lachlan River.

Other major irrigation schemes include the Burrendong Dam on the Macquarie River. It lies near Wellington and supplies water to the area. The Glenbawn Dam in the Hunter Valley was built both to store water for irrigation and to help in the control of floods in the area. The Keepit Dam in the Namoi River Scheme has made intensive irrigation possible. Because of the dam, farmers in the Namoi Valley can grow cotton. Another dam is the Copeton Dam on the Gwydir River, near Inverell. The Warragamba Dam on the Wollondilly River is the main source of Sydney's water supply.

Farming. In New South Wales, about 6 per cent of the people work in farming. Rearing sheep is the main type of farming in almost every part of New South Wales except the coastal region. Nearly 36 per cent of all sheep in Australia are found in this state. Many farmers combine fat lamb rearing with other types of farming, such as wheat farming. The main beef cattle areas are in the coastal regions and on the tablelands and western slopes. Most dairy farmers in the state have farms on flat land near rivers. The main areas for dairy farming are the northern and southern coasts, and areas west of Sydney and Newcastle that supply milk to these centres. Wheat makes up almost half of the state's total crop production. Most wheat farmers also grow other crops, including canola (also known as rape). Areas suitable for wheat are usually used to rear sheep as well.

The irrigated areas of the state, such as the Murray and Murrumbidgee irrigation areas in southern New South Wales, are important fruit-growing regions. Grapes and *stone fruit,* such as peaches, plums, nectarines, and cherries, grow well in these areas, along with citrus fruit. Stone fruit, apples, and pears also grow in the plateau areas of New South Wales that have mild climates. The eastern foothills of the Blue Mountains area and the hillsides between Sydney and Newcastle produce citrus fruit. Fruit growers in the northern coastal districts of the state grow such tropical fruit as bananas and pineapples.

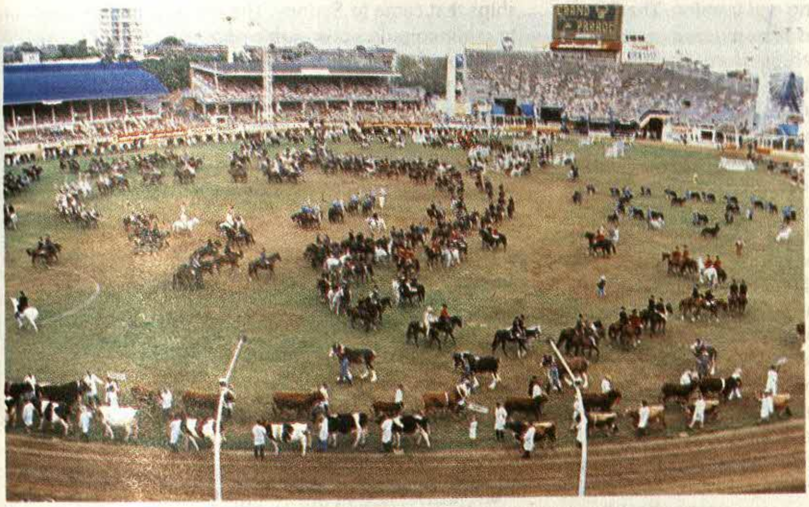
Farmers in northern New South Wales grow sugar cane on river flats around the Tweed, Clarence, and Richmond rivers. Farms around the Namoi and Macquarie rivers grow most of Australia's cotton. The Murrumbidgee area of New South Wales produces 90 per cent of the country's rice.

Fishing is an important industry in New South Wales. There are fishing grounds along the whole coast. Such fish as flathead, leatherjacket, mullet, snapper, tuna, and whiting find a ready market. Crabs, crayfish, oysters, and prawns are popular shellfish.

Mining. Huge deposits of black coal are mined in the Hunter Valley, Lithgow, and Wollongong areas of New South Wales. About 20,000 people work in the coal-mining industry in the state. Mines in New South Wales produce half of the black coal mined in Australia.

Broken Hill is the state's chief metal-mining centre. Nearly 4,000 miners work on the lodes that produce silver, lead, and zinc at Broken Hill.

Cobar is an important copper-producing area. Tin deposits are worked in the New England district and at Ardlethan in the Riverina.



New South Wales lies in southeastern Australia. State agricultural societies stage annual shows where livestock are judged. The grand parade at Sydney's Royal Easter Show, *left,* displays some of the country's finest livestock.

Manufacturing. New South Wales is well known for its farming. But more people work in factories than on farms. Manufacturing is economically more important than farming.

Sydney is the largest industrial city. Newcastle and Wollongong are also large manufacturing centres. Factories in these cities manufacture agricultural implements, chemicals, clothing, fertilizers, glassware, machinery, motorcars, paper, and textiles.

Iron and steel output of New South Wales is manufactured at Port Kembla and Newcastle.

Transport and communications. The state has five main highways. The Hume Highway and the Prince's Highway link Sydney with Melbourne. The Pacific Highway and the New England Highway link Sydney with Brisbane. The Great Western Highway extends west from Sydney to Bathurst, where motorists can take the Stuart Highway to the border town of Wentworth, or the Mitchell and Barrier highways to Broken Hill.

The state government operates a railway system that extends throughout the state. People can travel from Sydney to Melbourne and Brisbane in fast, air-conditioned, stainless steel trains that are driven by modern, diesel-electric locomotives.

The state has five main railway lines. The Illawarra line runs south from Sydney along the coast to Nowra. The southern line runs from Sydney to Melbourne. The western line links Sydney with the cities of western New South Wales, such as Bathurst and Broken Hill. The northern line was the first to connect Sydney and Brisbane. The north coast line links Sydney with towns in northern New South Wales on the way to Brisbane.

Sydney has two airports, but only Kingsford Smith Airport, at Mascot, is of international standard. The Kingsford Smith Airport serves many overseas airlines. Air services link Sydney with the other state capitals and with Canberra. A network of air services links about 50 towns and cities within the state.

Good ports and harbours exist along the whole coast. But only four ports—Sydney, Newcastle, Port Botany, and Port Kembla—handle ships from other states and from other countries.

The Australian Broadcasting Corporation and various independent companies operate radio and television stations throughout New South Wales. There are 26 national broadcasting stations and 45 commercial stations. The state also has 15 national television stations and 12 commercial stations. There also are 31 public and community radio stations.

Leading newspapers published in Sydney go by air, rail, and road to all parts of the state every day. Country centres publish their own papers.

History

The first European to sight the part of Australia now called New South Wales was the British navigator James Cook. He sailed along most of the eastern coast in 1770 and landed briefly at Botany Bay. Cook gave New South Wales the name it still bears.

In the late 1700's, British prisons became overcrowded. The British government decided to send a group of convicts, with Royal Marines as guards, to form a settlement at Botany Bay.

In May 1787, the First Fleet set out from England on its long voyage. The man in charge of the ships, Marines, and convicts was Arthur Phillip. He became the first governor.

When Phillip reached Botany Bay, he found it unsuitable for a settlement. He then sailed a few kilometres to the north and found a safe and beautiful harbour at Port Jackson. The deep water allowed the ships to anchor close to the shore. Phillip's men also found a source of fresh water, a small stream called the *Tank Stream.* It flowed into a bay now called *Sydney Cove.* Here, on Jan. 26, 1788, the new colony was set up.

The first settlers had many difficulties. They found that the poor, sandy soil around the settlement would not produce crops easily. They did not have enough fresh water and food. They did not have enough tools, and the ones they had were of poor quality. The convicts were lazy and knew little of building and farming. The Royal Marines did not like acting as prison guards. Despite these difficulties, Phillip never lost heart. He believed in a bright future for the new colony.

The worst problem, lack of food, was not solved until better soil was discovered in the Hawkesbury River Valley. A settlement was established there, in 1794, on the present site of Windsor. James Ruse, a convict, became the first man to grow wheat successfully.

When the convicts arrived in Sydney, they were made to labour on government works or they were assigned to work for free settlers or officers. Convicts who broke the law in the new settlement were handled harshly. Some were flogged. Others were sent to more severe penal settlements, such as Norfolk Island, where they were forced to work in chains.

A woman convict, if married to another convict, could stay with him. Otherwise, she was often sent to work as a servant for a free settler. A woman convict could also be employed at the Female Factory at Parramatta, where conditions were bad.

If convicts were highly skilled or well behaved, they were given a *ticket-of-leave.* The ticket-of-leave represented a form of parole that allowed them to live and work as free people. But they could not leave the colony. The governor could also pardon convicts before they had served their full sentences. Pardoned convicts were called *emancipists.*

If they were lucky, convicts could have fairly good lives. However, if they were unlucky enough to have a harsh master, or if they were reconvicted, they could be cruelly treated.

The Royal Marines were unhappy in the colony. As a result, a special army regiment was formed in Britain and sent to New South Wales to act as garrison. This regiment was the New South Wales Corps. The officers were given grants of land and allowed to use convict labour to develop farms. Ordinary soldiers, if they retired in the colony after completing their terms of service, were also given land.

The colony was generally peaceful, and as a result, the soldiers did not have much to do. The officers became more interested in making their own fortunes. They operated their farms and engaged in trading. They formed groups and bought entire cargoes from the ships that came to Sydney. The officers sold these goods to other colonists at a high profit. One kind of cargo was very popular and profitable. This cargo was alcoholic spirits, usually rum. The trade in rum created many problems. When the governors tried to stop the trade, the officers opposed them. In the end, the officers led a mutiny against Governor William Bligh in 1808 and took over the government. This action caused the end of the New South Wales Corps. It was recalled to Britain.

A new era began with the arrival of Governor Macquarie in 1810. Lachlan Macquarie was one of the most successful governors of New South Wales. Under his guidance, the colony developed and prospered. Macquarie encouraged exploration, and in 1813, the barrier of the Blue Mountains was crossed by Gregory Blaxland, William Lawson, and William Charles Wentworth.

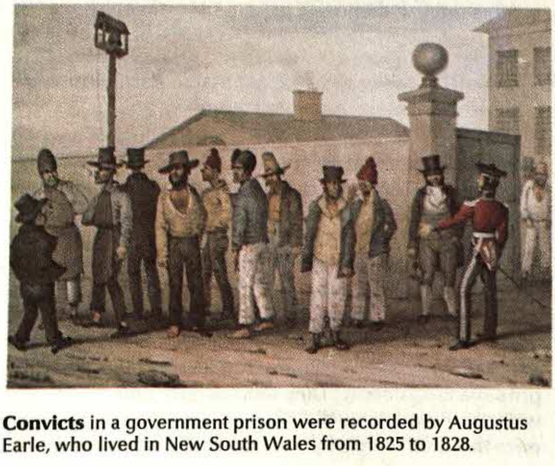
Whales were plentiful in Australian waters. By 1804, nine British ships were whaling off the Australian coast. In 1805, Sydney merchants built the first Australian whaling ship. By 1834, Sydney shipowners had almost 1,200 men as crews of 42 whalers.

The growth of sheep raising resulted in more exploration because the sheep growers required more and more pastureland. The main explorers were John Oxley, Charles Sturt, and Sir Thomas Mitchell.

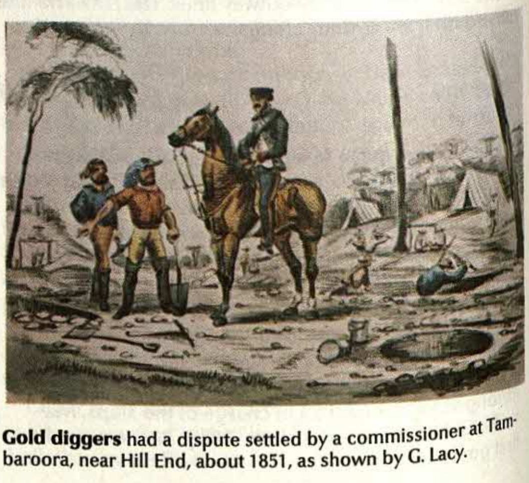
Cedar timber was a popular building material. By 1804, convicts were cutting cedar logs on the banks of the Hunter. Logs were hauled to the river by bullock teams. The logs were lashed together to form rafts and floated downriver to a timber yard. The cedar-getters went further and further north from Sydney. By 1830, they had reached Moreton Bay. By the 1890's, cedar had almost vanished from the eastern coast of Australia.

The free settlers did not like the fact that the governor had been given wide powers when New South Wales was set up as a prison colony. They wanted more freedom. Their leader was William Charles Wentworth, who had been a member of the expedition that had first crossed the Blue Mountains. Later, he became a lawyer, newspaper owner, and grazier. Wentworth wanted more representation in government for the citizens. The fight for self-government in New South Wales was largely won through his efforts.

In 1823, a small Legislative Council was set up to advise the governor on the laws he proposed to make for



Convicts in a government prison were recorded by Augustus Earle, who lived in New South Wales from 1825 to 1828.



Gold diggers had a dispute settled by a commissioner at Tambaroora, near Hill End, about 1851, as shown by G. Lacy.

Vaucluse House, in Sydney, was the home of William Charles Wentworth. The first constitution of New South Wales was drafted there.

the colony. In 1842, this council was enlarged, and some of its members were elected by the people. Finally, in 1851, all the Australian colonies were given the right to govern themselves in most matters. They were allowed to set up their own parliaments. The first New South Wales parliament met in 1856. Sir Stuart Donaldson was the first premier.

In 1851, Edward Hargraves discovered gold near Bathurst. Gold had been found before, but this time a rush to Bathurst took place. Many people left their work and went to the diggings. Many thousands of people migrated to Australia in search of gold. Many settled permanently in Australia.

In 1889, Sir Henry Parkes, then premier of New South Wales, urged that the six Australian colonies should join together to form a federal union. The union was finally established on Jan. 1, 1901. New South Wales became one of the six states of the Commonwealth. The first prime minister of Australia was Sir Edmund Barton, who was a well-known member of parliament and a strong supporter of the federal movement.

A period of prosperity after World War I was followed by the severe, worldwide economic depression of the 1930's. The state government gave relief work or the *dole* (unemployment benefits) to many people who were dismissed from their work. J. T. Lang, who was premier of New South Wales from 1925 to 1927 and from 1930 to 1932, put forward some reform policies that alarmed many people. In 1932, Sir Philip Game, the governor, dismissed Lang from the premiership.

The depression gradually lifted. Then, in 1939, World War II broke out. In 1942, Japanese submarines attacked Sydney. As it had done in World War I, New South Wales developed its industries during wartime. After the end of World War II in 1945, New South Wales continued to grow.

Related articles in ***World Book*** include:

Australia, History of
Botany Bay
Cook, James
Mount Kosciusko
Murray River
Newcastle
Sydney
Wollongong

Outline

I. Government
II. People
III. Education
IV. Visitor's guide
V. The land
  A. Location and size
  B. Land regions
VI. Climate
VII. Economy
  A. Natural resources
  B. Power and irrigation schemes
  C. Farming
  D. Fishing
  E. Mining
  F. Manufacturing
  G. Transport and communications
VIII. History

New South Wales Corps was an infantry regiment recruited in Britain to keep order in New South Wales, Australia, in the 1700's. The corps landed in Sydney in 1790 and 1791. Between 1792 and 1795, the commanders of the corps acted as lieutenant governors of the colony. The officers quickly established control over trade, especially the rum trade. They helped the colony become self-supporting through their trading and agricultural ventures. Governor William Bligh attempted to suppress the rum trade but was arrested by officers of the corps in 1808. The British government recalled the New South Wales Corps in 1810.

New Stone Age. See **Prehistoric people** (How prehistoric farmers lived); **Stone Age.**

New Sweden was the only Swedish colony in America. It extended along the Delaware River from the mouth of Delaware Bay to about what is now Trenton, New Jersey. Swedish settlers founded the colony in 1638, and built Fort Christina at what is now Wilmington, Delaware. The Dutch in New Netherland to the north tolerated Swedish competition in the fur trade as long as Sweden and the Netherlands were allies. In 1655, the Dutch took New Sweden by a threat of force.

New Testament is part of the Christian Bible. It is a record of the new *testament,* or promises made by God to humanity, as shown in the teachings and experiences of Christ and His followers.

Contents of the New Testament

Books. The New Testament consists of 27 books, and is about a third as long as the Old Testament. The first four books are the Gospels according to Matthew, Mark, Luke, and John. The Gospels represent a collection of the acts and words of Jesus. The authors wrote the Gospels for teaching purposes and as an expression of faith.

Detail of *The Conversion of Saint Paul* (1542-1545), a fresco by Michelangelo in the Pauline Chapel in the Vatican

An account in the New Testament describes Saint Paul's conversion to Christianity while he was on the road to Damascus.

The Acts of the Apostles, a continuation of the Gospel of Luke, is a volume of history. Twenty-one documents called *epistles,* or letters, follow. St. Paul is supposed to have written 13 of these; 7 books are the Epistles of Peter, James, John, and Jude; and the Epistle to the Hebrews is anonymous. The New Testament ends with the Book of Revelation, or Apocalypse.

The 27 books make up the *canon* of the New Testament, or all the books that Christians consider to be authoritative Scripture. During early Christian times, there were many books of religious writings, some of doubtful value and authority. These included fanciful gospels and acts designed to fill in details of the life of Jesus and His Apostles. By A.D. 400, church scholars regarded the present books of the New Testament as authoritative Scripture. They considered certain other religious writings as *apocryphal,* or of doubtful authorship. Later, church councils ratified the decisions regarding the canon.

Writing the New Testament. The original language of the New Testament is the common vernacular Greek that was widely used at the time of Jesus. The Greek in the New Testament includes some Hebrew phrases and idioms, because most of the New Testament writers were Jews. The authors of the original books of the New Testament wrote them on papyrus scrolls, none of which now exists. Scholars have used early Latin, Syriac, and Coptic translations of the Greek New Testament to help reconstruct the original text. They have also studied quotations of the New Testament. Several of these quotations appear in the writings of the church fathers as early as about A.D. 150.

Dating the New Testament

It is impossible to give definite dates for all the events of the New Testament, just as it is impossible to give definite dates for many other incidents in ancient history. But scholars have been able to set approximate dates by connecting Bible narratives with facts known from history.

The birth of Jesus. The Christian Era is represented by the Latin words *anno Domini,* which mean *in the year of our Lord.* The abbreviation A.D. is written before the year, as A.D. 1000.

Scholars have attempted to determine the date of Jesus' birth in several ways. In Matthew 2, we learn that Jesus was born during the rule of Herod the Great. Herod died in either 4 or 1 B.C. Some scholars believe that the birth of Jesus probably occurred sometime before that, probably between 6 and 1 B.C.

Another attempt to find evidence for the date of Jesus' birth concerns the star of Bethlehem. Johannes Kepler, a great German astronomer, said that two planets seemed to come together in the skies over Bethlehem in 7 B.C. They must have looked like one bright star.

More evidence comes from Luke's mention of a decree of the Emperor Augustus (Luke 2: 1-3). The emperor, according to Luke, ordered that "all the world should be enrolled." Scholars have found documents that seem to show that a *census* (count of the people) took place in 8 B.C. It may have been shortly after this time that Joseph and Mary went to Bethlehem.

Nothing in the Bible tells us the day or month when Jesus was born. But the 25th of December comes at about the time of year called the winter *solstice* (see **Solstice**). At this time, the days stop growing shorter as winter turns toward spring. The date serves as a symbol of the new life that came to the world when Jesus was born.

The public ministry of Jesus. The Gospel of Luke tells us that Jesus was about 30 years old when He began to preach (Luke 3: 23). The length of His public ministry is determined by the number of *Passovers* (annual Jewish Festivals) that He celebrated. The *Synoptic Gospels* (Matthew, Mark, and Luke) refer to only one Passover during Jesus' adult life, the one at the time of His Crucifixion. The Gospel of John mentions at least three Passovers, and the feast mentioned in John 5: 1 may have been a fourth Passover. The mention of these Passovers has led many scholars to believe Jesus' public ministry lasted for about three or four years.

The Crucifixion. All the Gospels imply that Jesus was crucified on a Friday. All except John tell us that this Friday was the day after Passover. In John, the Crucifixion occurs on the day of the Passover. Many scholars believe that the Crucifixion took place on either April 7, A.D. 30, or April 3, A.D. 33. The Jewish year differs in length from the calendar year now in general use. This difference makes it necessary to go through a complicated process of determining when Jesus died according to the calendar of the Christian Era.

The conversion of Paul followed several incidents described in the opening chapters of Acts. These were the holiday of Pentecost, the organization of the church, and the martyrdom of Stephen. Paul was probably converted between A.D. 34 and 37.

Paul's missionary journeys. Paul and Barnabas brought food to the Christians at Jerusalem because of an expected famine, according to Acts 11: 27-30. Non-Biblical records show that a famine did occur in Judea about A.D. 46, during the rule of Claudius (41-54). Therefore, the visit of Paul and Barnabas must have taken place about A.D. 45 or 46. Paul made his first missionary journey soon afterward, and thus it must have occurred in A.D. 47 or 48. Two other missionary journeys followed. Then Paul was arrested in Jerusalem and put into prison by Felix, the Roman governor of Judea. Festus became governor two years later, and he allowed Paul to plead his cause before Herod Agrippa II. These references to names recorded in history make it possible for scholars to fix fairly precise dates for several events in Paul's life. An interesting inscription found at Delphi dates the governorship of Gallio (Acts 18: 12) in A.D. 50 or 51.

Paul was probably in prison at Caesarea for two years, beginning about A.D. 58. From there, he was taken to Rome, where he remained in custody for two more years. Many scholars believe he wrote the Epistles to the Philippians, the Colossians, Philemon, and the Ephesians during this time.

Some scholars think that Paul may have made a missionary journey to Spain in about A.D. 64, and that he was again put in prison in Rome about the year 66. Tradition says that he died a martyr during the rule of Nero (54-68). We know that this emperor put a number of Christians to death after the burning of Rome in order to turn people's suspicions away from himself.

Critical studies of the New Testament

The original manuscripts of the books of the New Testament, as they were written by early Christians, have all been lost. Only copies remain, and none of them dates from the time when the Apostles were still living. Thousands of later copies exist. Many variations of wording occur in the old copies, although the variations in the Greek manuscripts rarely affect the meaning of the passage. However, these differences have made it difficult to determine the original wording of some of the passages.

Efforts to determine original wordings through careful study and comparison of old manuscripts have sometimes met with opposition. But most church officials now accept such studies as necessary to determine the purpose and the original meaning of the Biblical writings. A study of this kind is called *criticism.* Biblical criticism is divided into two classes, lower criticism and higher criticism.

Lower, or textual, criticism is concerned with the recovery of the author's own wording, before copies were made. The process of making copies gave rise to errors, most of which were accidental. Lower criticism requires a great deal of research and comparison, and scholars have spent years of work on it. They have put together all the variations of wording for the passages of the New Testament, and for the wording of the Old Testament as well.

Higher criticism covers a broader field than textual criticism. Higher critics learn what they can of the Bible by comparing one passage with another. They also compare statements in the Bible with literary and historical works of the period. They study the literary form of the Biblical writings. By such means they can draw conclusions concerning the nature and authenticity of the sacred record.

Higher critics have not always agreed in their findings. The more extreme higher critics have made such prejudiced interpretations that the general movement has at times met with hostile charges. Sometimes these charges are well-founded and sometimes not. Most people believe that many good results have come from a wise and unprejudiced study of the Bible. The advanced schools of religious studies teach the New Testament in the light of all that modern learning and scholarship have achieved.

Related articles. See **Bible** and its list of *Related articles.* See also the following articles on books of the New Testament:

Acts of the Apostles
Colossians, Epistle to the
Corinthians, Epistles to the
Ephesians, Epistle to the
Galatians, Epistle to the
Gospels (Matthew, Mark, Luke, John)
Hebrews, Epistle to the
James, Saint (Epistles of)
John, Epistles of
Jude, Epistle of
Peter, Epistles of
Philemon, Epistle to
Philippians, Epistle to the
Revelation, Book of
Romans, Epistle to the
Thessalonians, Epistles to the
Timothy
Titus

New Thought is a philosophical and religious movement that originated in the United States during the mid-1800's. Supporters of New Thought believe that the human mind is superior to all material conditions and circumstances. They assert that each person is an individualized centre of God, and that God is immediately accessible to people through the power of the mind. Accordingly, a person can solve any problem by properly applying mental force. New Thought resembles the ideas of Ralph Waldo Emerson, an American transcendentalist philosopher (see **Transcendentalism**).

New town is a town in the United Kingdom that has grown rapidly as a result of a government decision. Each new town has been planned as a whole. The rapid growth of new towns has been sponsored by government investment in houses, factories, and roads. New towns contrast sharply with ordinary towns, which grew slowly and did not follow an overall plan.

Most ordinary towns developed naturally because their site had some advantage, such as a sheltered harbour or a coalfield. But a new town site is the result of deliberate government intentions.

Many new towns are *overspill towns,* providing homes and jobs for people who have moved out of crowded cities. For example, Harlow and Basildon were built as overspill towns for London.

Some new towns were set up to serve particular social or industrial purposes. For example, Peterlee, in Durham, was built to provide homes and jobs for miners whose villages decayed after local coal mines were closed.

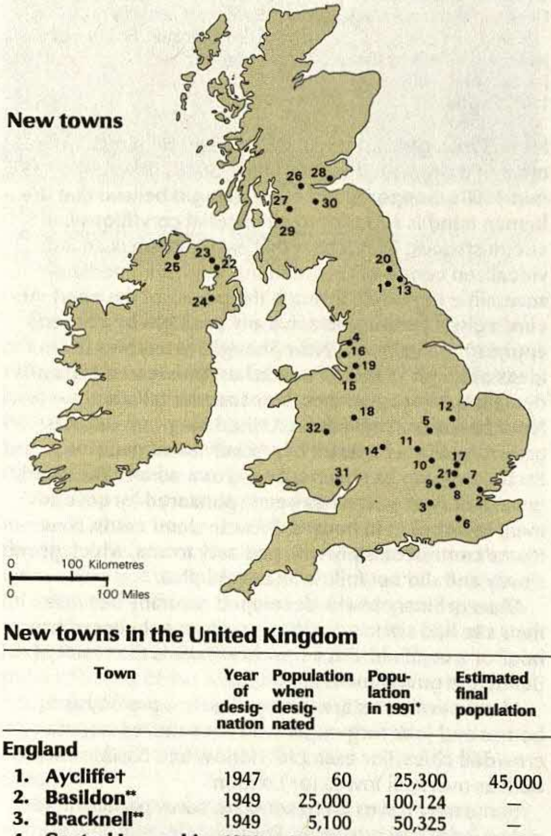
As a result of good planning and abundant government investment, new towns contain much fine architecture and good housing. They also have social amenities, such as sports stadiums, theatres, and other recreational facilities.

The greatest problem that faced new towns in their early phase of development arose from the fact that most of the inhabitants were new to the area. Often they found it difficult to start a new social life away from their friends and relations. They also lacked many social amenities. New towns begun more recently have been based on established towns, with already existing social amenities.

There are 32 new towns in the United Kingdom: 21 in England; 4 in Northern Ireland; 5 in Scotland; and 2 in Wales. The combined population of these towns is more than 2 million.

The Republic of Ireland has no new towns as such. But Shannon, in County Clare, has developed as a centre of rapid growth around the duty-free airport there. The airport offers big tax deductions and other advantages to manufacturers and warehouses prepared to operate from the airport's industrial estate. Its growth has paralleled that of many of the new towns in the United Kingdom. In 1991, Shannon's population was 7,920.

New towns



Organization

New towns have been built on sites *designated* (fixed) by the central government. A government-appointed *development corporation* supervises a new town's early planning and growth.

When a new town reaches its estimated final population, the development corporation is *dissolved* (abolished). The corporation's assets in the project are disposed of by the Commission for the New Towns in England and Wales.

Northern Ireland has four new towns: Antrim, Ballymena, Craigavon, and Londonderry. They are run by the Northern Ireland Department of the Environment as part of its general urban development strategy. These new towns are called *district towns.*

History

In the 1800's, many working people in big cities lived crowded together in appalling conditions. As a result, some industrialists built the first entirely new planned communities for their workers. Examples are Saltaire, near Bradford, and Port Sunlight, in Merseyside. Ebenezer Howard planned the first complete new towns—Letchworth (1903) and Welwyn Garden City (1919). Both were privately financed.

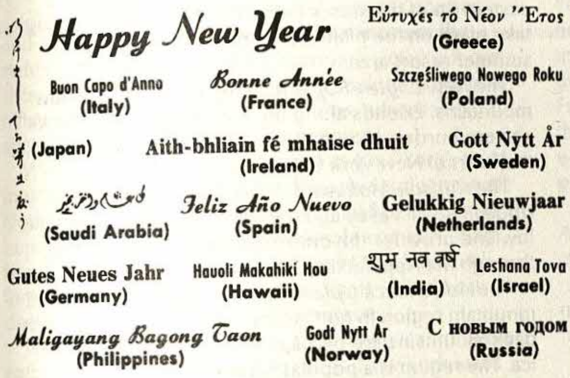
The New Towns Act of 1946 enabled the British government to designate and finance new towns. By 1950, 14 new towns were started. The early new towns were spacious.

During the 1950's, only two new towns were designated—Corby and Cumbernauld. Corby followed the pattern set in the 1940's, but Cumbernauld was more compact. During the 1960's and early 1970's, more new towns were designated. Most of these were much larger than earlier new towns. Many were based on existing towns.

New towns in the United Kingdom

Town	Year of designation	Population when designated	Population in 1991*	Estimated final population
England				
1. Aycliffe†	1947	60	25,300	45,000
2. Basildon**	1949	25,000	100,124	—
3. Bracknell**	1949	5,100	50,325	—
4. Central Lancashire	1970	235,000	249,184	285,000
5. Corby**	1950	15,700	53,044	—
6. Crawley**	1947	9,100	88,700	—
7. Harlow**	1947	4,500	74,630	—
8. Hatfield**	1948	8,500	25,500	—
9. Hemel Hempstead**	1947	21,000	79,463	—
10. Milton Keynes	1967	40,000	176,330	200,000
11. Northampton	1968	131,100	180,567	170,000
12. Peterborough	1967	80,500	138,370	150,000
13. Peterlee	1948	200	31,200	30,000
14. Redditch**	1964	32,000	78,100	—
15. Runcorn**	1964	28,500	65,984	—
16. Skelmersdale	1961	10,000	40,083	61,000
17. Stevenage**	1946	6,700	75,152	—
18. Telford‡	1968	70,000	139,516	130,000
19. Warrington	1968	124,000	152,896	160,000
20. Washington	1964	20,000	61,500	80,000
21. Welwyn Garden City**	1948	18,500	41,726	—
Northern Ireland (District towns)				
22. Antrim	1965	13,000	47,600	—
23. Ballymena	1967	15,000	57,300	—
24. Craigavon	1965	40,000	78,200	—
25. Londonderry	1969	72,000	72,334	—
Scotland				
26. Cumbernauld	1955	3,000	47,922	70,000
27. East Kilbride	1947	2,400	84,750	82,500
28. Glenrothes	1948	1,100	37,500	70,000
29. Irvine	1966	36,000	33,681	120,000
30. Livingstone	1962	2,000	40,800	70,000
Wales				
31. Cwmbran	1949	12,000	47,762	55,000
32. Newtown	1967	5,500	10,097	11,000

*1991 census (final figures).
†Also called *Newton Aycliffe.*
**Assets transferred to the Commission for New Towns.
‡Part of Telford was designated as Dawley in 1963.



People around the world celebrate the new year with special greetings, *above.* Some people wear a dragon costume during a Chinese New Year celebration, *right.*

New Year's Day is the first day of the calendar year. People in almost every country celebrate this day as a holiday. The celebrations are both festive and serious in most countries.

In Asia, the new year is a time of gaiety. The Chinese celebrate with parades, fireworks, and great merrymaking. They decorate their homes, and give each other presents. In Europe and in North America, people celebrate by holding family parties, giving presents, and visiting friends. Some people make new year *resolutions* to correct bad habits.

On *New Year's Eve* (the day before New Year's Day), parties are held in some countries to "watch the old year out". On the stroke of midnight, people in Britain "let in the new year" by joining hands to form a circle and singing the song "Auld Lang Syne" (Long Ago) (see **Auld lang syne**). The Scots call the festival *Hogmanay,* and celebrate it with great festivities.

Early customs. Many ancient peoples started the year at harvest time. They performed rituals to do away with the past and purify themselves for the new year. For example, some people put out the fires they were using and started new ones.

The early Egyptians celebrated the new year when *Sothis,* the dog-star, appeared in daylight about the same time that the Nile began to overflow its banks. They held religious ceremonies, because their economic life depended on the annual flooding.

The ancient Mesopotamians held their new year festival at the time of the spring rains. The Babylonians regarded the new year as a most critical time. They believed that at that time the god Marduk decided the destiny of the country for the coming year.

The ancient Romans gave each other New Year's gifts of branches from sacred trees. In later years, they gave gold-covered nuts or coins imprinted with pictures of Janus, the god of gates, doors, and beginnings. January was named after Janus, who had two faces—one looking forward and the other looking backward.

The Romans also brought gifts to the emperor. The emperors eventually began to demand such gifts. But the Christian church outlawed this custom and certain other pagan New Year's practices in A.D. 567.

The ancient Persians gave New Year's gifts of eggs, which symbolized productiveness. The Celtic priests of what is now England gave the people branches of mistletoe, which was considered sacred.

The Celts took over many New Year's customs from the Romans, who invaded Britain in A.D. 43. By the 1200's, English rulers had revived the Roman custom of asking their subjects for New Year's presents. Common presents included jewellery and gold. Queen Elizabeth I acquired a large collection of richly embroidered and jewelled gloves through this custom. English husbands gave their wives money on New Year's Day to buy pins and other articles. This custom disappeared in the 1800's. However, the term *pin money* still means small amounts of spending money.

Modern customs on New Year's Day include visiting friends and relatives; giving gifts; attending religious services; and making noise with guns, horns, bells, and other devices. Children in Belgium write their parents New Year's messages on decorated paper. The children read the messages to their families on New Year's Day. In Japan, many people worship on New Year's Day. In many Japanese homes, the day is celebrated with ceremonial housecleaning, feasting and exchanging visits and gifts. A sacred rope may hang over the house entrance to keep away evil spirits.

Large numbers of people go to New Year's Eve parties. At midnight, bells ring, sirens sound, fireworks are let off, and everyone shouts, "Happy New Year!" People may also drink a toast to the new year and sing "Auld Lang Syne".

The date of New Year. During the Middle Ages, most European countries used March 25, a Christian holiday called Annunciation Day, to start the year. By 1600, many Western nations had adopted a revised calendar called the Gregorian calendar. This calendar, which is the one used today, restored January 1 as New Year's Day.

Many people celebrate the new year on dates established by their religion. For example, the Jewish New Year, a solemn occasion called Rosh Ha-Shanah, is observed during September or early October (see **Rosh Ha-Shanah**). Hindus in different parts of India celebrate the new year on various dates. Muslims use a calendar that has 354 days in most years. As a result, the Muslim New Year falls on different dates from year to year on the Gregorian calendar.

New York, a state on the East Coast of the United States, is the country's leading centre of banking, communication, and finance. Only California outranks New York in trade and manufacturing.

New York City is the largest city in the country in population and one of the largest in the world. It is one of the world's leading centres of business. Its many theatres, museums, musical organizations, and other institutions makes it a great cultural centre. New York City is also one of the world's biggest and busiest seaports. In its harbour stands the Statue of Liberty, long a symbol of freedom to people in all parts of the world. The United Nations headquarters is in New York City.

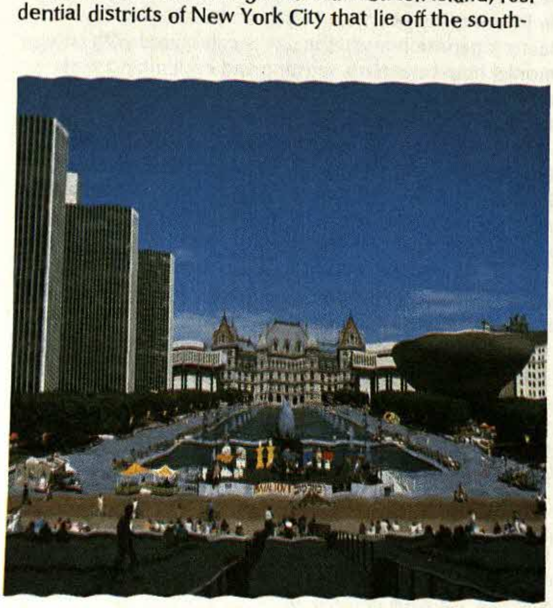
The state of New York is also a land of fertile river valleys, forested hills, tall mountains, and sparkling lakes. New York's many scenic features draw millions of tourists each year. Niagara Falls, the state's most magnificent natural wonder, is one of the chief attractions.

New York was one of the original 13 states of the United States. About a third of all the battles of the American Revolution were fought in New York. New York City was the first capital of the United States. George Washington took the oath of office there as the nation's first president. The New York state capital is in Albany.

Land. During the Ice Age, which ended about 10,000 years ago, a thick sheet of ice spread across almost all the area of what is now New York. It formed many of the state's most striking natural features.

New York City has one of the world's great natural harbours. The state's most important rivers, the Hudson and the Mohawk, form one of the country's important trade routes. Most of New York's several thousand lakes lie in the Adirondack region of northeastern New York. Lake Erie and Lake Ontario, which form part of the U.S.-Canadian border, are New York's largest lakes.

New York has eight distinct land regions. The *Atlantic Coastal Plain* covers Long Island and Staten Island, residential districts of New York City that lie off the southeastern tip of the state's mainland. Fishing and farming take place on the plain. Long Island is also a popular summer resort area.



The Empire State Mall in Albany includes the State Capitol, *centre,* and other government buildings.

The *New England Upland,* a region of hills and low mountains, extends along the lower half of New York's eastern border. Also in the region is Manhattan Island, the heart of New York City.

The *Hudson-Mohawk Lowland* covers most of the Hudson River Valley and the Mohawk River Valley. The lowland provides the only natural navigable passage through the Appalachian Mountains.

The *Adirondack Upland* is a roughly circular hill and mountain region in northeastern New York. The Adirondack Mountains are perhaps the oldest in North America. The region is a popular recreation area.

The *Tug Hill Plateau,* an isolated part of the Appalachian Plateau, is a relatively flat, rocky area with a harsh climate. It receives more snow than anywhere in the United States east of the Rocky Mountains.

The *St. Lawrence Lowland* lies along the south bank of the St. Lawrence River and north of the Adirondack Upland. The land in this region is level or rolling.

The *Erie-Ontario Lowland* is a low plain south and east of Lake Erie and Lake Ontario. It has many swamps and oval-shaped hills called *drumlins.* Fruit farming is a specialism in its fertile soils. The Niagara River forms its famous waterfall in this region.

The *Appalachian Plateau,* also known as the *Allegheny Plateau,* covers much of the southern half of the state. In the western and central portions of the plateau, ice-deepened valleys separate broad uplands. At the Finger Lakes, the deepest valleys are now occupied by long, deep lakes. The Catskill Mountains, an all-year-round holiday area, rise in the south and east.

Economy. New York has a varied economy. Its excellent location, large population, and outstanding transportation facilities have helped make it a leader in business and industry. New York ranks among top U.S. states in many economic sectors, and provides nearly 8 per cent of the jobs in the country.

Service industries, taken together, account for about four-fifths of New York's *gross state product*—the total value of goods and services produced annually. Finance, insurance, and property form the single most important economic activity in the state. New York City, the nation's leading financial centre, is the home of most of the largest U.S. banks. The New York Stock Exchange is the nation's largest securities exchange.

Facts in brief about New York

Population: 17,990,455.
Area: 127,189 km².
Climate: *Average January temperature*— −6° C. *Average July temperature*—21° C.
Elevation: *Highest*—Mount Marcy, 1,629 m. *Lowest*—sea level along the Atlantic Ocean.
Largest cities: New York City (7,322,564), Buffalo (328,123), Rochester (231,636), Yonkers (188,082).
Chief products: *Agriculture*—milk. *Manufacturing*—printed materials, scientific instruments, electrical equipment, machinery, chemicals. *Mining*—stone.
Origin of name: The Duke of York, later King James II of England.
Nickname: The Empire State.

Community, social, and personal services, the second-ranking service industry, employs more of the state's workers than any other economic activity. It consists of a wide variety of businesses, including doctors' offices and private hospitals, law firms, advertising agencies, and entertainment companies.

Wholesale and retail trade ranks as New York's third most valuable service industry. The wholesale trade of clothing, grain, groceries, jewellery, and petroleum is important in the state. Many wholesale companies are based in New York City. The city's port handles much foreign trade. Major types of retail firms include car dealerships, food stores, and restaurants.

New York ranks second only to California among the nation's leading manufacturing states. New York leads all other U.S. states in printing and publishing. New York City is the centre of the U.S. publishing industry.

The Rochester area produces most of the scientific instruments manufactured in the state. The production of photographic equipment is especially important there. The chief centres of the electrical equipment industry are Binghamton, Buffalo, New York City, Rochester, the Nassau-Suffolk metropolitan area, Schenectady, and Utica.

New York leads all states in the production of clothing and related products. New York City ranks as the nation's chief centre for the production of women's clothing and makes large amounts of men's clothing.

Livestock and livestock products provide about 70 per cent of New York's agricultural income. Milk is the leading product. Hay and maize are the state's leading crops. New York is a leading centre of fruit and vegetable production in the Eastern United States.

New York lies in the heart of the most thickly populated part of the nation. It is the chief gateway to the United States from other countries. It not only has an outstanding harbour but also an excellent system of inland waterways. All these factors have helped New York become a national leader in transportation. Bustling airports, major seaports, great bridges, and New York City's busy underground railway are other important transportation facilities.

History. Two of the largest and most powerful Indian groups in North America lived in the New York region before white settlers arrived. One group consisted of tribes of the Algonquian family of Indians. The other was the Iroquois, or Five Nations group.

In 1609, Henry Hudson, an Englishman employed by the Dutch, sailed up the river that now bears his name. His voyage gave the Netherlands a claim to the territory covering much of New York and other eastern states. The territory was later named *New Netherland.*

The Dutch established trading posts and settlements in the Hudson River Valley soon after Hudson's visit. In 1624, Dutch settlers founded Fort Orange (now Albany), the first permanent white settlement in the colony. The Dutch bought Manhattan from the Indians in 1625 and began to build the city of *New Amsterdam,* now New York City.

Many English colonists settled on Long Island. They gradually began to oppose the Dutch. In 1664, the English seized New Netherland. They renamed the territory *New York,* after the Duke of York.

Soon after the English won control of southern New York, the French began to take great interest in the northern part. Meanwhile, in 1689, war had broken out in Europe between England and France. New York soon became a battleground between the two countries. From 1689 until 1763, the region suffered severely through four wars, known as the French and Indian wars. The wars cost France almost all its North American possessions.

New York was the scene of many battles during the American Revolutionary War (1775-1783). In 1777, American patriots in New York won two important battles.

In 1779, a military expedition crushed the mighty Iroquois, leaving the Indians' territory open to white settlement. New York became a state of the U.S. in 1788.

War broke out between the United States and Britain in 1812, and fighting took place near the U.S.-Canadian border. After the war, pioneers began to settle in the northern and western sections of the state.

In 1825, the Erie Canal was completed, linking the Hudson River and the Great Lakes and greatly expanding trade with the West (see **Erie Canal**). The development of railways soon followed. By 1850, New York led the nation in population, in manufacturing, and in commerce.

After the American Civil War (1861-1865) ended, new manufacturing centres grew up in various parts of New York. New York City, already the nation's industrial and financial capital, also became a cultural centre. Employment opportunities brought new waves of immigrants.

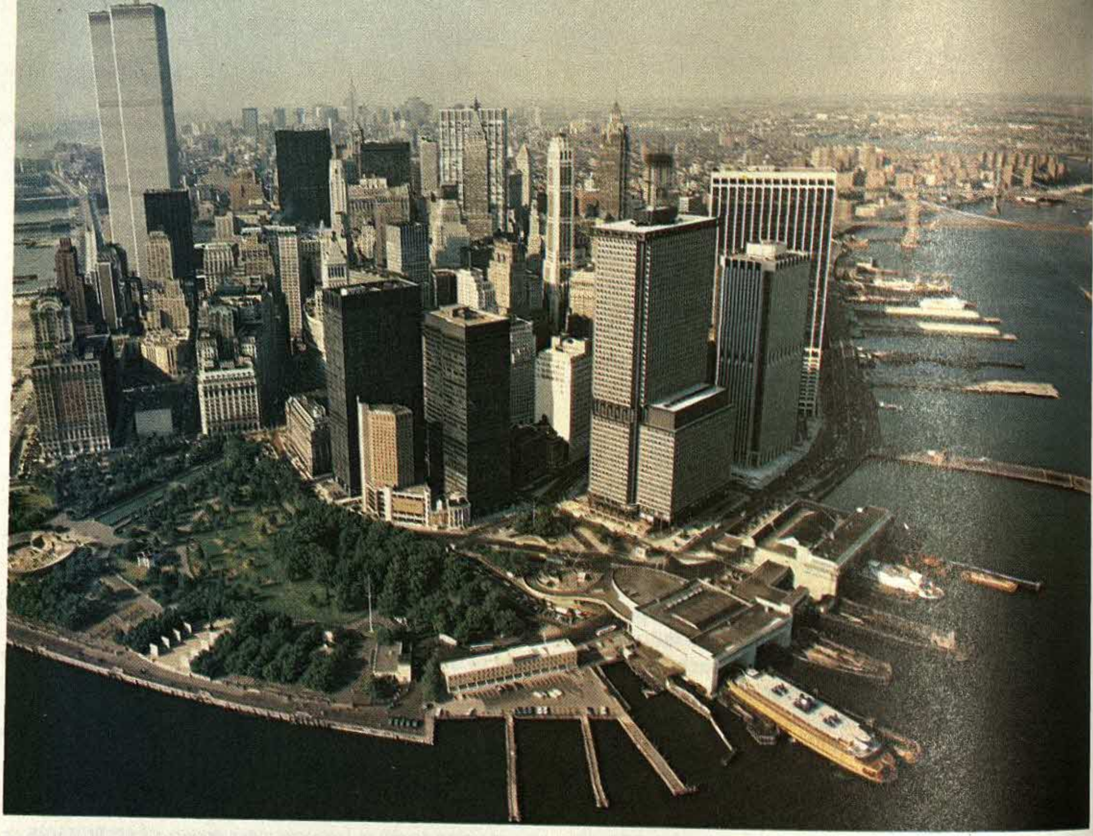
In 1901, an assassin killed President William McKinley in Buffalo. Vice President Theodore Roosevelt, a former governor of New York, became President.

New York became a centre of the U.S. defence industry in the mid-1900's. The St. Lawrence Seaway opened in 1959, allowing ocean-going ships to sail to ports on the Great Lakes.

During the early 1970's, many manufacturing plants in New York closed. But after the mid-1970's, the economy experienced a healthy recovery, mainly because of tremendous growth in service industries and electronics manufacturing. In 1986, New York voters approved a bond act to finance environmental projects, especially the cleaning up of hazardous waste sites.

See also **New York City; Buffalo.**

New York, with its harbour on the North Atlantic coast, is the chief gateway to the United States from other countries.



New York City is best known for the giant skyscrapers on Manhattan Island. The twin towers of the 110-storey World Trade Center, *left,* rise above the city's financial district. New York City is the largest city in the United States in population.

New York City

New York City (pop. 7,322,564) is the largest city in the United States in population (see **City**). New York City is one of the world's most important centres of business, culture, and trade. It is also the home of the United Nations (UN). Much of what happens in New York City affects what happens throughout the United States and around the world.

New York City has a population of more than 7 million. It is more than twice as large as any other city in the United States. In fact, only eight states—not including New York State—have more people than New York City. Since its founding by Dutch settlers in 1625, New York has attracted immigrants from throughout the world. During the 1800's and early 1900's, millions of Europeans seeking a better life in a free land poured into the city. The Statue of Liberty, erected in New York Harbor in 1886, became the symbol of this new life. Since the mid-1900's, more immigrants—mainly blacks from the Southern States and Spanish-speaking Americans from Puerto Rico—have moved into the city. These people have also looked to New York as a place to make a better life for themselves.

The business, financial, and trading organizations in New York City play a major role in the economy of the nation and of the world. The banks, stock exchanges, and other financial institutions in the city's famous Wall Street area help to provide the money used by most large U.S. corporations. The skyscrapers that form the spectacular New York skyline house the headquarters of many national and international business firms. The docks, warehouses, and shipping companies that line New York's huge natural harbour handle much of the nation's imports and exports.

As a cultural centre, New York City has no equal in the United States. Most of the publishing houses that select and produce the nation's books have their headquarters in New York. The city's world-famous Broadway area is the centre of professional theatre in the United States. New York is also the home of some of the nation's largest museums and art galleries. The city displays beautiful Gothic churches and other interesting styles of architecture. A great number of outstanding orchestras and opera and dance companies give performances at the Lincoln Center for the Performing Arts.

But along with all its greatness, New York City has many serious problems. Thousands of immigrants have not found the opportunities they had hoped for in New York. More than a million New Yorkers receive welfare or social security aid, and thousands live in slums. Other problems include air pollution, traffic jams, crime, drug abuse, ethnic conflicts, and the ever-increasing cost of living in the city. All these problems are driving many families—especially white middle-class families—to the suburbs.

In spite of its problems, New York City remains one of the most interesting and exciting of U.S. cities.

The city

New York City lies in the southeast corner of New York State at the mouth of the Hudson River. It covers about 956 square kilometres, including about 174 square kilometres of inland water. The city is divided into five areas called *boroughs*—Manhattan, the Bronx, Queens, Brooklyn, and Staten Island. Each is a county of New York State.

Manhattan, the smallest borough in area, covers 88 square kilometres. It occupies a long, narrow island bordered by the Hudson River on the west, the East River on the east, the Harlem River on the north and northeast, and Upper New York Bay (the mouth of the Hudson) on the south.

The Bronx lies across the Harlem River from Manhattan and covers 143 square kilometres. It extends north along the Hudson River and east along the East River. It is the only borough not separated from upstate New York by water.

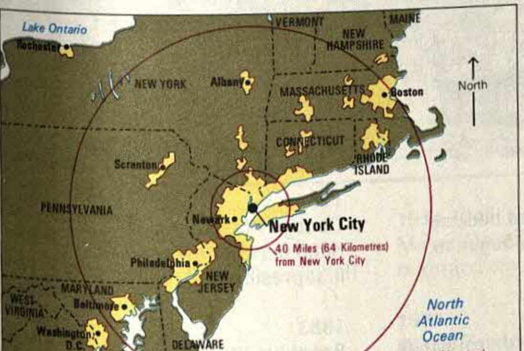
Queens, the largest borough in area, occupies 326 square kilometres on the northwest corner of Long Island. The East River separates Queens from the Bronx to the north and from Manhattan to the west.

Brooklyn covers 288 square kilometres on the southwest tip of Long Island. It lies south and southwest of Queens and southeast of Manhattan across the East River.

Staten Island, formerly called the borough of Richmond, occupies a 168-square-kilometre island in Upper and Lower New York bays. It lies west of Brooklyn and southwest of Manhattan.

The state of New Jersey is directly west of New York City. It lies across two waterways, Arthur Kill and Kill Van Kull, from Staten Island; across Upper New York Bay from Brooklyn; and across the Hudson River from Manhattan and the Bronx.

Manhattan is the oldest and most important borough of New York City. It is about 21.7 kilometres long and 3.8 kilometres wide at its widest point. But about 1½ million people live there. The borough has the city's tallest buildings, some of the nation's largest schools and colleges, and the world's most famous financial and theatrical districts.



New York City lies at the centre of a megalopolis, a group of metropolitan areas. These areas, shown in yellow on the map extend from Boston to Washington, D.C.

Manhattan is an area of many sharp contrasts. Some of the richest people in the United States live in its beautiful town houses and luxurious high-rise blocks of flats. But some of the nation's poorest people occupy its *tenements* (shabby blocks of flats) and low-rent public housing projects. Most of Manhattan is covered with concrete and asphalt, and skyscrapers make many of its streets look like deep canyons. But the borough's Central Park provides 340 hectares of grass, trees, and rolling hills. Manhattan has some of the world's most exclusive shops and largest department stores. They attract shoppers from all parts of the country. But the borough also has tiny shops that sell to nearby residents.

New York City's Financial District lies at the southern tip of Manhattan and is centred on Wall and Broad streets. Many large banks, brokerage houses, and stock exchanges have their headquarters along the district's narrow streets. The giant World Trade Center rises in the Financial District along the Hudson River. The centre includes twin 110-storey towers.

Broadway, one of New York City's longest and best-known streets, begins in the Financial District and runs north and northwest across the length of Manhattan. On the east side of Broadway, a few blocks north of the Financial District, stands the Municipal Civic Center. The centre includes City Hall, handsome courthouses, and other government buildings.

Residential and commercial neighbourhoods lie to the north and northeast of the Municipal Civic Center. These neighbourhoods include Chinatown, Little Italy, and the Lower East Side. Both Chinatown and Little Italy have some of the city's oldest tenements. They also have many restaurants that specialize in Chinese or Italian food. For many years, most immigrants to New York City have first settled on the Lower East Side because of its many low-rent tenements. Jews once made up the largest group in the area, and they still own many shops there. Today, Puerto Ricans are the largest single group on the Lower East Side. But other groups, especially students and artists, have also been attracted to the Lower East Side by the low rents.

Greenwich Village lies west of Broadway and the Lower East Side. It attracts artists, writers, musicians, actors, and other people in the arts. The Village has a variety of housing, many interesting shops and art galleries, and several small theatres. Many people in the arts also live in the SoHo area, south of the Village.

North of Greenwich Village, Manhattan is laid out in a regular pattern of cross streets. Avenues run north and south, and numbered streets run east and west. Broadway cuts diagonally across this pattern.

Central Park, which runs from 59th to 110th streets between Fifth Avenue and Central Park West, separates Manhattan's Upper East Side and Upper West Side. The Upper East Side has long been the most fashionable neighbourhood in Manhattan. At one time, the area had many town houses that were owned by the city's richest residents. Today, cultural organizations and United Nations delegations occupy many of these buildings, and most of the people in the area live in luxurious blocks of flats. The Upper West Side is chiefly a middle-class

New York City *Cultural and Business Centre of the U.S.*

Lies on East Coast of United States at mouth of Hudson River. Big, diverse and exciting, sixth largest city in the world (city pop. 7,322,564).

International centre of business, culture, trade. Influences United States and rest of the world. Major centre of printing and publishing. Clothing industry traditionally in Manhattan's famous Garment District. Long prominent as a centre of culture and entertainment. Often called "Big Apple."

The Guggenheim Museum, *above,* displays art in a circular building designed by the famous American architect Frank Lloyd Wright. The museum was founded in 1937.

The Statue of Liberty, *right,* is a world-famous symbol of freedom. It stands on Liberty Island in New York Harbor. France gave the statue to the United States in 1884.

Central Park, *above and right,* lies in the centre of Manhattan. The park covers 340 hectares. Wooded paths, ponds, lakes, statues, a zoo, and recreational facilities add to its attractions. Landscape architects Frederick Law Olmsted and Calvert Vaux designed the park in 1857.

The New York Stock Exchange, *right,* is at the corner of Wall and Broad streets, the heart of the city's financial district. Banks, brokerage houses, and stock exchanges make up the district. Visitors may observe the activities at the New York Stock Exchange from a viewing gallery. The Exchange was founded in 1792.

1609
The Netherlands claimed New York City region.

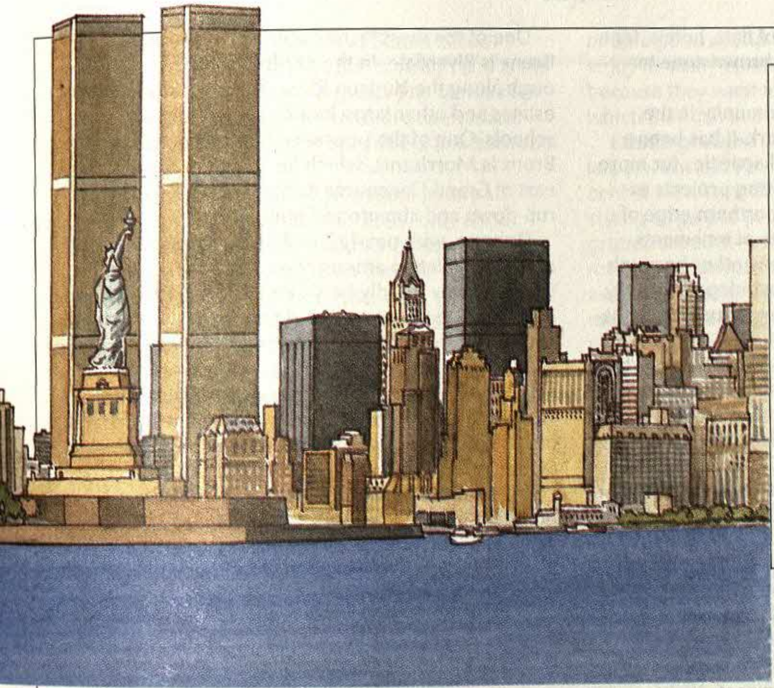
1625
Dutch settlers laid out a town at tip of Manhattan island. Settlement soon named New Amsterdam.

1647
Peter Stuyvesant became governor. Town began to prosper rapidly.

1664
English gained control of colony and renamed it New York. Later lost then regained control.

1789
George Washington inaugurated in New York as nation's first president.

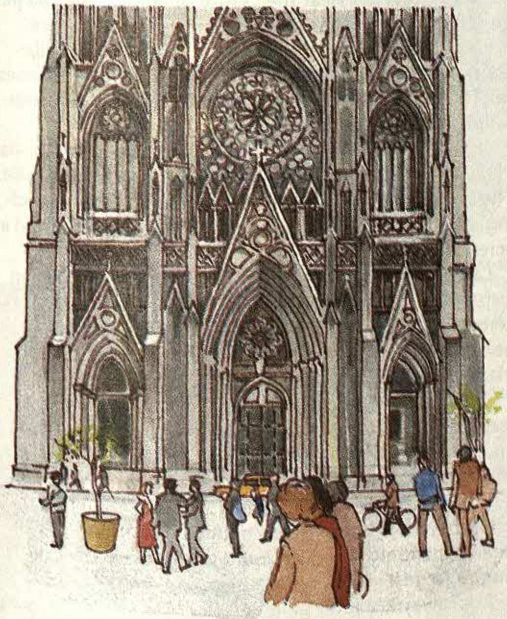
1883
Brooklyn Bridge opened; first direct link between Manhattan and Brooklyn.



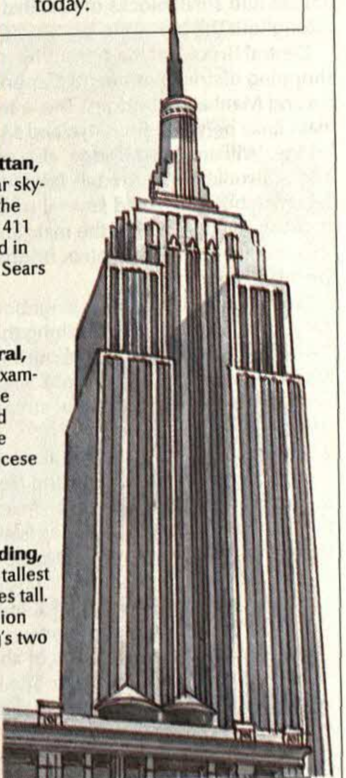
City divided into five areas called *boroughs*—Manhattan, the Bronx, Queens, Brooklyn, and Staten Island.

Since its founding, city has attracted immigrants from throughout world. Statue of Liberty—built in France, shipped to the United States, reassembled in New York Harbor, and dedicated in 1886—became symbol of immigrants seeking better life in a free land. Wide variety of ethnic groups in city today.

Skyscrapers in Manhattan, *above,* form a spectacular skyline. The twin towers of the World Trade Center rise 411 metres. They rank second in height behind Chicago's Sears Tower.



Saint Patrick's Cathedral, *left,* is one of the finest examples of architecture in the Gothic style in the United States. It is the seat of the Roman Catholic Archdiocese of New York.



The Empire State Building, *right,* one of the world's tallest skyscrapers, is 381 metres tall. Each year, about 2½ million people visit the building's two observation decks.

1904
City's first subway—Interborough Rapid Transit (IRT)—opened.

1931
Empire State Building completed. At that time, it was world's tallest building.

1934-1945
Mayor Fiorello La Guardia reformed city politics.

1973
World Trade Center, 411 metres tall, dedicated; headquarters of many trading firms.

1975
Financial crisis resulted from city government's inability to pay all bills for the year.

1981
Edward I. Koch elected mayor. First ever nominated by both Democratic and Republican parties.

neighbourhood. It has many blocks of flats, hotels, tenements, and long blocks of brick and brownstone terraced houses.

Harlem, the best-known black community in the United States, lies north of Central Park. It has been a centre of black business and cultural activities for more than 60 years. A series of model housing projects extends along the Harlem River at the northern edge of Harlem. But much of the area consists of tenements.

Brooklyn has more people than any other borough of New York City. If Brooklyn were an independent city, its population of about $2\frac{1}{4}$ million would make it the nation's fourth largest city.

Brooklyn is an important port and industrial centre. Hundreds of ships carry freight to and from Brooklyn's docks each year. The borough's factories, most of which are along the waterfront, make a wide variety of goods.

Housing in Brooklyn ranges from large houses and towering blocks of flats to small cottages and run-down boarding houses. But most *Brooklynites* live in terraced houses and small blocks of flats that line the streets throughout the borough.

Central Brooklyn, the borough's main business and shopping district, lies near the approaches to the Brooklyn and Manhattan bridges. These two bridges are the main links between Brooklyn and Manhattan. A third bridge, Williamsburg Bridge, also connects the two boroughs. Brooklyn's centre has large department stores, tall office buildings, and several schools and colleges. Flatbush Avenue, one of the main streets of the central area, begins at the Manhattan Bridge and runs through the heart of the borough.

Two of Brooklyn's oldest neighbourhoods, Brooklyn Heights and Cobble Hill, lie along the East River west of the central area. These neighbourhoods have more than 1,000 houses over 100 years old. Many of the houses stand on handsome, tree-lined streets and are carefully preserved.

Coney Island lies at the southern tip of Brooklyn. The area once was an island, but land has been filled in to make it a peninsula. In summer, many New Yorkers travel by underground to Coney Island's beaches and to its famous Boardwalk, which has side shows, souvenir stands, and other attractions. At one time, Coney Island also had great amusement parks, but they have been replaced by housing developments.

The Bronx has a population of about $1\frac{1}{4}$ million and is chiefly a residential borough. The western part of the Bronx consists of a series of hills and valleys crossed by boulevards. A major boulevard in the Bronx, the Grand Concourse, runs north and south through the area. It is lined with blocks of flats, office buildings, and shops. The eastern section of the borough is a broad plain, with peninsulas extending into the East River and Long Island Sound.

Bronx Park lies in the centre of the Bronx. It includes Bronx Zoo, one of the best-known zoos in the United States, and the New York Botanical Garden, an important scientific institution.

Fordham University and Lehman College have handsome campuses to the west of Bronx Park. The campus of Bronx Community College of the City University of New York includes the Hall of Fame, which honours the memory of great Americans.

One of the most fashionable neighbourhoods in the Bronx is Riverdale, in the northwest corner of the borough along the Hudson River. It has tall blocks of flats, estates and other large homes, and exclusive private schools. One of the poorest neighbourhoods in the Bronx is Morrisania, which lies south of Bronx Park and east of Grand Concourse Boulevard. The area has many run-down and abandoned buildings.

Queens, with nearly 2 million residents, ranks second in population among New York City's boroughs. Queens grew rapidly between 1910 and 1930, when underground systems were built to connect it with Manhattan. A second period of fast growth began in the late 1940's, when the underground systems were extended, new roads were built, and two major airports were developed in the borough. Today, huge housing developments and busy motorways are the major features of Queens.

Much of the borough's industry is concentrated near the East River in an area called Long Island City. The area lies just south of the Queensboro Bridge, which connects Queens and Manhattan. It has giant rail yards of the Penn Central Railroad and many industrial plants and warehouses. Maspeth, southeast of Long Island City, also has large industrial plants, as well as pleasant residential areas.

Forest Hills lies near the centre of Queens. Within this neighbourhood is Forest Hills Gardens, an attractive housing and shopping area built in 1910. Forest Hills Gardens was intended for families with middle incomes. But it immediately became—and has remained—a community for the wealthy.

Northeast of Forest Hills is Flushing Meadow-Corona Park, site of the New York World's Fair of 1939 and 1964. The park has several features left from the fairs, including a botanical garden, an indoor ice-skating rink, and a science museum.

La Guardia Airport, one of New York City's two main airports, is northwest of Flushing Meadow-Corona Park, across Flushing Bay. The neighbourhood of Flushing, northeast of the park, has a busy shopping area and many large blocks of flats.

Jamaica, in southeastern Queens, is one of the borough's chief commercial centres. It has large shopping and business areas and both rich and poor residential sections.

John F. Kennedy International Airport, the city's largest airport, lies immediately south of Jamaica. It has been expanding since 1942 and has become the borough's largest single source of employment.

Rockaway is a long peninsula that forms the southern border of Jamaica Bay. It has a sandy beachfront, attractive private homes, and modern blocks of flats. It also has many summer holiday cottages.

Staten Island has about 352,000 residents, making it the smallest borough in population. It is the only borough not connected to Manhattan by a bridge or a tunnel. Until the completion of the Verrazano-Narrows Bridge in 1964, much of the island consisted of small farms and undeveloped areas. The bridge, which connects Staten Island with Brooklyn, has led to the construction of new housing and to industrial growth. However, many of the communities on Staten Island still look more like suburban towns than sections of a major city.

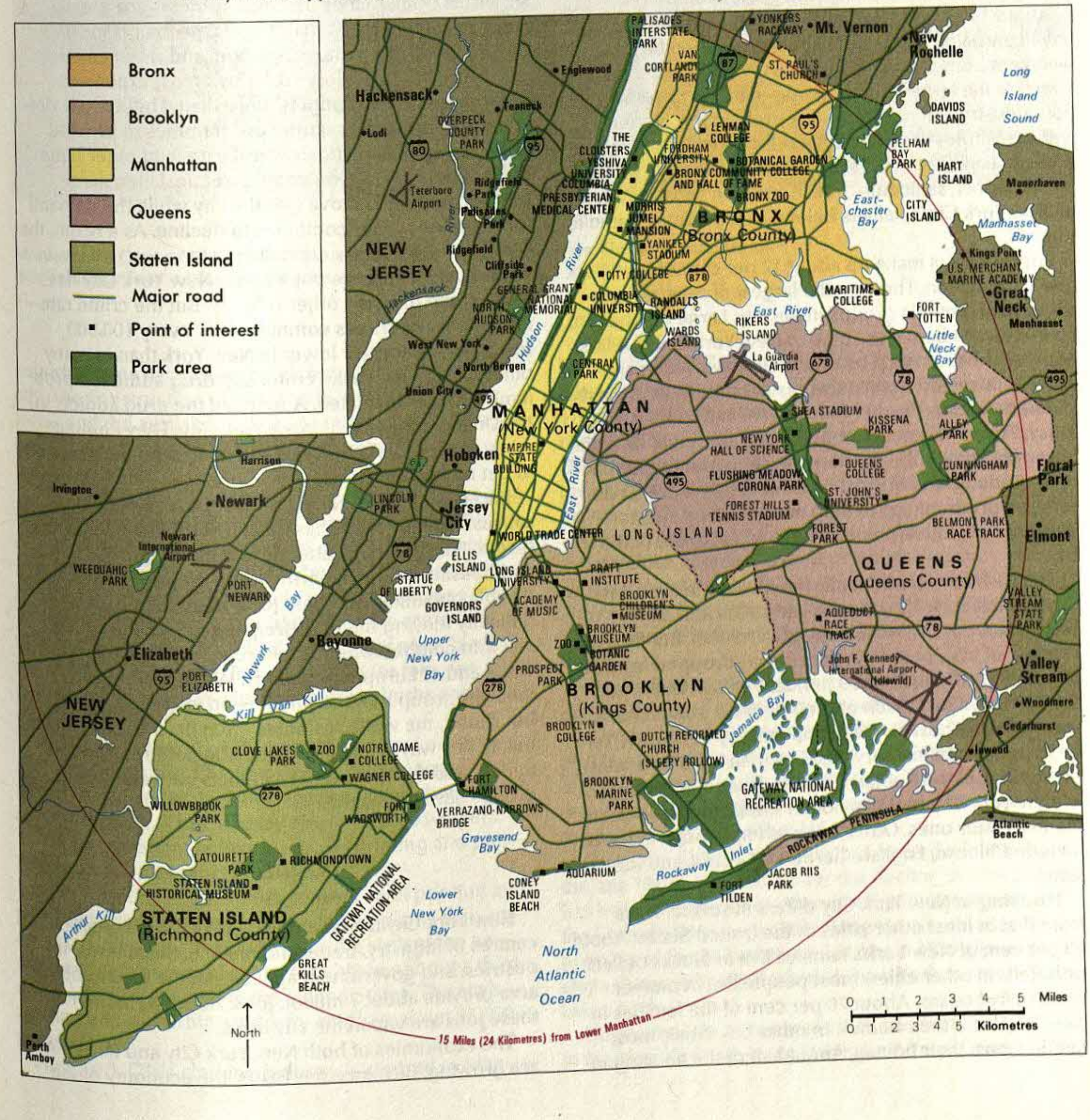
St. George, on the northeast tip of Staten Island, serves as the business section of the borough and is the site of the Staten Island Ferry Terminal. The famous ferries carry cars and passengers between Staten Island and Manhattan and provide the only direct link between the two boroughs.

The people of New York City represent nearly all races and nationalities. During the 1650's, only about 1,000 people lived in the Dutch colony of New Amsterdam on Manhattan Island. But even then, 18 languages were spoken in the colony. Since that time, people from throughout the world have brought their skills, traditions, and ways of life to New York City.

People move to New York City for many reasons. Many are attracted by the city's job opportunities. Other people go to attend the city's schools and colleges or to enjoy its many cultural activities. Still others go simply because they want to be a part of a large, exciting city in which they can live almost any way they choose.

Ethnic groups. Five ethnic groups—black, Irish, Italian, Jewish, and Puerto Rican—make up about 75 per cent of New York City's people. Neighbourhoods consisting largely of people from these and many smaller groups are scattered throughout the city. Originally, most of the people in ethnic groups shared direct ties to a country, a language, or a common past with other members of their group. Today, this is less true. But the people still have some bonds of unity through such concerns as common religious beliefs and economic interests.

New York City This map shows the five boroughs of New York City—the Bronx, Brooklyn, Manhattan, Queens, and Staten Island. These boroughs are also counties of the state of New York. County names appear in parentheses under each borough name.



Blacks are the largest ethnic group in New York City and make up about 25 per cent of the city's population. New York has about 1,784,000 blacks, more than any other city in the United States. Most of the blacks are immigrants—or the children of immigrants—from the rural South. But many have also arrived from the West Indies. A large number of New York City's blacks live in poor neighbourhoods. Many of them have been prevented from leaving the ghetto areas by discrimination in jobs and housing and by a lack of education. But more and more black New Yorkers are becoming part of the city's middle class. Thousands of blacks live in racially integrated areas, and thousands more live in middle-class black neighbourhoods.

Jews make up about 20 per cent of New York City's population. New York's Jews come from many countries. But they are considered an ethnic group because most of them live in Jewish neighbourhoods and have similar religious and social beliefs. Many Jews own businesses. Many others work in garment factories, in offices, and in the legal, medical, and teaching professions.

About 14 per cent of New York City's people are of Italian ancestry. New York Italians are known for their well-kept homes and for their close neighbourhood ties. They are the largest single group in the city's construction industry, and they play a key role in the restaurant and the wholesale and retail food-marketing industries. Many Italians have civil service jobs in the city's park, public works, sanitation, police, and fire services. Most of New York City's Italians belong to the Roman Catholic Church.

Puerto Ricans make up about 12 per cent of New York City's population. They are the largest of several Spanish-speaking ethnic groups in the city. Large numbers of Puerto Ricans began to come to New York in the 1950's. Many of them found jobs as unskilled workers, especially in hospitals, hotels, and restaurants. At first, nearly all Puerto Ricans lived in East Harlem in Manhattan. But today, Puerto Rican neighbourhoods are found in all the boroughs. Neighbourhood associations, large church organizations, and the state school system have all developed programmes to help newly arrived Puerto Rican people to learn English and adjust to life in the city.

The Irish have traditionally been active in New York City's political life. During the late 1800's and early 1900's, they controlled the city government. But the percentage of Irish people in the city has dropped from 30 per cent in 1870 to about 9 per cent today. As a result, the Irish have lost much of their political power. But they are still the largest single group employed by New York City's police and fire services. The Irish are also among the leaders of the Roman Catholic Church in the city.

New York City has many other ethnic groups besides the five major ones. Other large ethnic groups in the city include Chinese, English, Germans, Greeks, and Russians.

Housing in New York City differs in several ways from that in most other cities of the United States. About 65 per cent of New York's families live in blocks of flats or hotels. In other cities, most people live in one- or two-family houses. About 70 per cent of the families in New York rent their homes. In other U.S. cities, most families own their homes. About half of the housing in New York City was built before 1940. Most other cities in the United States have a far larger percentage of newer housing.

Housing remains one of New York City's most serious and difficult problems. Many old buildings are becoming unusable, and the demand for new housing, especially among poor people, is rapidly increasing. Yet steadily rising construction costs and a lack of large areas of open land make the development of new housing difficult.

Education. New York City has the largest state school system of any city in the United States. Many of New York City's colleges, universities, and other institutions of higher learning are world famous. One of the largest universities in the world, the City University of New York, is operated by the city with state and federal assistance. The university has a total enrolment of about 180,000 students.

Social problems. New York City has many of the same problems other cities have. But it is so much larger than other cities that the problems are greatly magnified. New York's major social problems include poverty, crime and drug addiction, and racial conflict.

Poverty is one of New York City's most expensive problems. The city budgets more than 4 billion U.S. dollars a year on social security programmes to provide food, clothing, housing, medical care, and other benefits for about 1½ million people. Yet unskilled immigrants continue to move into the city while the demand for unskilled labour continues to decline. As a result, the problem of poverty is difficult to solve.

Because of its large population, New York City has more crime than any other U.S. city. But the crime rate—the number of crimes committed for every 100,000 residents—is actually lower in New York than in many other cities. New York's crime and drug addiction problems are closely related. About half the drug addicts in the United States live in New York City. They commit many of the city's burglaries and attacks on individuals to get money for drugs.

Racial conflicts in New York City have had many causes. A major cause has been discrimination against blacks, Puerto Ricans, and other minority groups in jobs and housing. Many minority group members have had trouble obtaining well-paid jobs. Many also have had difficulty moving out of segregated neighbourhoods and into neighbourhoods where most of the people are white and of European ancestry. When members of a minority group have begun moving into such a neighbourhood, the white residents often have begun moving out. In this way, segregated housing patterns have continued, and the chances for conflicts between the groups have increased.

Economy

New York City is one of the world's most important centres of industry, trade, and finance. Businesses, industries, and government agencies in the metropolitan area provide about 7 million jobs. About 3⅓ million of these jobs are within the city itself.

The economies of both New York City and its suburbs are growing. But since the 1940's, the economy of the

Manhattan's Central Park attracts many people on warm summer days. The huge park has athletic fields, gardens, a lake, playgrounds, wooded areas, and a zoo.

suburban area has grown much faster than that of the city. The construction of new roads, a growing labour force, and the availability of land in the suburbs have led many businesses and industries to move *from* the crowded central city to the suburbs.

The types of jobs available in New York City have also been changing since the 1940's. The number of jobs for unskilled workers has decreased greatly because many industries have moved to the suburbs. This decrease has created a serious economic problem because most immigrants to the city are unskilled. At the same time, the number of jobs for skilled workers, especially office workers, has increased. But many of these jobs are being filled by people who live in the suburbs and commute to the city.

Industry. New York City ranks third after Los Angeles-Long Beach and Chicago among the leading manufacturing centres in the United States. It has about 17,000 industrial plants. They employ about 430,000 workers. The most important industries are (1) printing and publishing and (2) clothing production.

New York City is one of the nation's chief printing and publishing centres. It has more printing plants than any other U.S. city. New York does about a sixth of the nation's printing and publishing. It publishes about a third of the books published in the United States. The city's printing and publishing industry employs about 93,000 people.

New York City's clothing industry is centred in Manhattan's famous Garment District, southwest of Times Square. There, hundreds of factories employ about 119,000 people. But the garment industry has been declining in New York City. Many factories have closed. Other factories have left the Garment District because of the rising costs of doing business in the heart of Manhattan.

Other leading manufacturing industries include those that produce chemicals, food products, furniture, machinery, metal products, paper products, and textiles. The construction industry is also important. About 87,000 people in the city work in jobs related to the industry.

Trade. New York City's port, officially called the Port of New York and New Jersey, is one of the world's largest and busiest seaports. It employs about 200,000 people. The total value of the cargo it handles exceeds that of any other port in the United States. The port's cargo includes foreign imports and exports, and goods going to and coming from other U.S. ports.

New York City's port activity has been declining since the late 1940's. One reason for the decline in port activity has been the growth of other international seaports in the United States, especially along the Great Lakes. The opening of the St. Lawrence Seaway in 1959 allowed ships that previously docked in New York to reach Great Lakes ports.

Large amounts of cargo are also handled at airports in the New York City area. Foreign air freight goes through Kennedy Airport and nearby Newark International Airport in New Jersey. Domestic cargo is handled at Kennedy, La Guardia, and Newark airports.

Finance. More of the nation's largest and most important financial institutions have their headquarters in New York City than in any other city. Banks, brokerage houses, insurance companies, property firms, stock exchanges, and other financial organizations in New York employ about 495,000 people. Unlike most industries in the city, the financial organizations offer a steadily increasing number of jobs.

The most famous financial institution in New York City is the New York Stock Exchange, located at the corner of Broad and Wall streets in the heart of the Financial District. It is the largest stock exchange in the world.

Transportation. New York City has a huge, complicated transportation system. Much of the transportation system in the city is centred in the area of Manhattan that is south of Central Park. About 3½ million people travel to and from that area each working day.

An extensive road system has been developed to carry cars, buses, and trucks into, out of, and through New York City.

New York City includes 168 square kilometres of inland water, so many bridges and tunnels are needed to link the city's boroughs. The famous Brooklyn Bridge crosses the East River and connects Brooklyn and the southern tip of Manhattan. It was completed in 1883 and declared a national historic landmark in 1964. Eight other bridges cross the East River.

Communications. New York City is the nation's most important centre for mass communications. More publishing and broadcasting companies have their headquarters located in New York than in any other city in the United States.

New York City has nearly 60 radio and television stations and serves as the headquarters of the nation's four major broadcasting networks.

Cultural life and recreation

New York City ranks as one of the world's greatest cultural centres. It has many art galleries, drama and dance groups, musical and literary societies, and other cultural organizations. It also has some of the world's finest concert halls, museums, and theatres. Many of the nation's greatest actors, artists, musicians, poets, and writers live in New York.

There are several reasons for New York City's leading position as a cultural centre. Many of the city's wealthy residents have long given financial support to cultural activities. Traditionally, the city has also offered people in the arts an atmosphere that encourages freedom of expression. In addition, New York's many advertising agencies, broadcasting and film studios, recording companies, and publishing houses have provided jobs that attract creative people.

The arts. Nearly all the arts thrive in New York City. Many new styles in American drama, literature, music, and painting have developed in New York and then spread to the rest of the country.

One of New York City's most famous and popular forms of art is the theatre. Most important American plays and musical comedies have their premières in the city's famous Theatre District. The theatres in this district are called *Broadway* theatres, though few are actually on that street. Most are on side streets near Times Square. Many plays and musicals are also presented in *off-Broadway* and *off-off-Broadway* theatres in Manhattan and Brooklyn.

Musical organizations in New York City include the New York Philharmonic, one of the world's great symphony orchestras, and the Metropolitan Opera Association, an outstanding opera company. Both perform at the Lincoln Center for the Performing Arts.

Architecture. New York's best-known style of architecture is the towering skyscraper. The giant buildings that form Manhattan's dramatic skyline are famous throughout the world.

One of the oldest and most famous skyscrapers in New York is the Flatiron Building, located on 23rd Street where Broadway crosses Fifth Avenue. The 21-storey building was completed in 1903. It has a triangular shape like that of an old-fashioned flatiron.

During the 1930's, several famous skyscrapers were built in New York City. The most famous, the 102-storey Empire State Building, was completed in 1931. It ranked as the world's tallest building for many years.

Many glass-walled skyscrapers have been built in New York since the 1950's. These buildings include the United Nations Secretariat along the East River at 44th Street, Lever House on Park Avenue between 53rd and 54th streets, and the Seagram Building on Park Avenue between 52nd and 53rd streets. The twin towers of the giant World Trade Center on the Hudson River southwest of City Hall were completed in 1973.

History

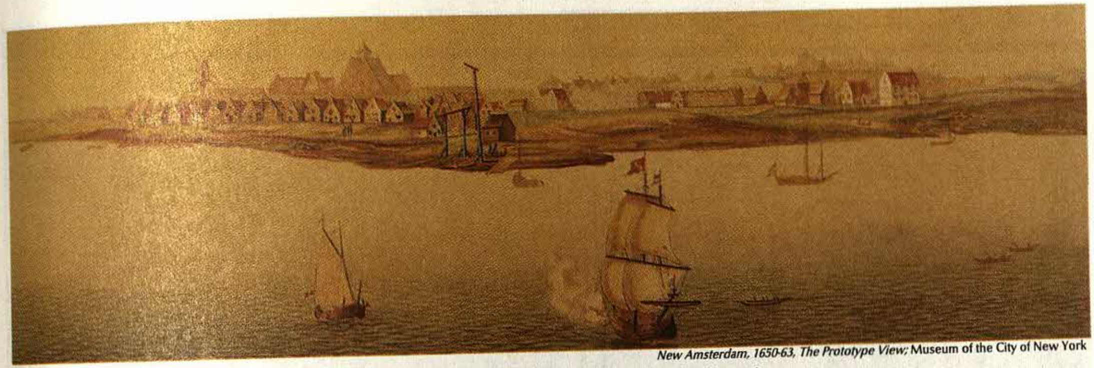
The earliest people known to have lived in the New York City area were American Indians. Several tribes of the Algonquian family of Indians lived peacefully on the shores of New York Harbor and along the banks of the Hudson and East rivers. The Indians lived in small villages of bark huts. They fished, hunted, grew crops, and trapped animals. They travelled the area's waterways in sturdy canoes.

Exploration. The first European to enter New York Harbor was probably Giovanni da Verrazano, an Italian explorer employed by the king of France. Verrazano and his crew landed on Staten Island in 1524, while exploring the North American coast.

In 1609, Henry Hudson reached Manhattan and then sailed up the river that now bears his name. Hudson was an Englishman exploring for the Dutch, and so the Netherlands claimed the territory he had found. The region was later named New Netherland.

Settlement. In 1624, the Dutch West India Company, a trading and colonizing firm, sent the first settlers to Manhattan. In 1625, the settlers laid out a town and built a fort called Fort Amsterdam at the island's southern tip. Soon after Fort Amsterdam was built, the entire settlement was named New Amsterdam.

While New Amsterdam was being established on Manhattan, colonists were also arriving in what is now the Bronx, Brooklyn, and Queens.



New Amsterdam, 1650-63, The Prototype View; Museum of the City of New York

New Amsterdam was a Dutch settlement that became New York City. The settlers laid out the town on Manhattan Island in 1625. By the 1650's, New Amsterdam had about 1,000 residents.

English rule. The Netherlands and England fought three naval wars between 1652 and 1674. In 1664, English warships forced the surrender of New Amsterdam. The Dutch regained the colony a few years later but then gave it to England under the terms of a peace treaty. The English renamed the colony New York.

New York grew quickly under English rule. New York played an important role in the American Colonies' fight for freedom from Britain. In 1765, the Stamp Act Congress met in New York to protest against unfair taxes. In 1770, New Yorkers clashed with British soldiers, and one man was killed in the fighting. Soon after the American Revolution began in 1775, American forces took possession of the city. But the British regained New York after the Battle of Long Island in 1776 and held it until the war ended in 1783. In January 1785, New York became the temporary capital of the United States, and Congress met there until August 1790. George Washington was inaugurated in New York as the nation's first president in April 1789.

The growing city. During the 1800's, thousands of European immigrants arrived in New York City every year. Until about 1890, most of them were from Germany, Ireland, and other countries of northern and western Europe. After about 1890, most immigrants were from southern and eastern European countries. Many immigrants had difficulty adjusting to the city. They lived in crowded slums and had trouble finding jobs.

Politicians, especially members of the Democratic Party machine in Manhattan called Tammany Hall, offered jobs, gifts, and advice to immigrants. In return, the immigrants voted to keep Tammany Hall in power. But the politicians actually did little to provide the immigrants with better housing, education, and medical care.

Formation of Greater New York. In 1883, engineers completed the Brooklyn Bridge, which provided the first direct link between Manhattan and Brooklyn. In 1898, Brooklyn and several communities in what became the Bronx, Queens, and Staten Island were united with Manhattan to form what was called Greater New York. The sprawling new city had more than 3 million residents.

But Manhattan remained the largest and most powerful borough of Greater New York, and so its Tammany Hall organization continued to control city politics. Occasionally, voters became angered enough by the illegal activities of Tammany leaders to elect mayors who promised reform. But none of these reform mayors lasted more than one term—until Fiorello La Guardia became mayor in 1934. La Guardia, an honest and outspoken reformer, served from 1934 to 1945. Since his administration, no political machine has been able to control New York politics.

Recent developments. Since the 1940's, New York City has been troubled by many problems. These problems have grown severe since the early 1960's. Air and water pollution have harmed New York City's environment. Roads and mass transportation systems have become overcrowded and outdated. Housing shortages have increased. Ethnic conflicts have worsened. New York City has also faced a series of damaging strikes by public employees. Many agencies have been set up to study and deal with New York City's problems.

In 1975, the city's government lacked enough money to pay all its bills for the year. The state legislature helped ease the situation by establishing the Municipal Assistance Corporation, which lent the city some money. The federal government also provided funds. To help pay its expenses during the late 1970's, New York City increased city taxes, eliminated thousands of city government jobs, and reduced city services.

Democrat Edward Koch was elected mayor of New York City in 1977. In 1981, he became the first person ever nominated as mayor by both the Democratic and Republican parties. He easily won reelection. During the 1980's, New York City's economic situation improved. Koch was reelected in 1985. In 1989, David Dinkins became New York City's first black mayor. He served until 1993.

In 1993, a bomb exploded in a car park beneath the World Trade Center. The blast killed six people and injured more than 1,000. It caused extensive damage to the building. In 1994, four men were convicted of involvement in the bombing. The men were thought to have ties with Arab lands.

Related articles in *World Book* include:

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Ellis Island
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Hudson River
Manhattan Island
Metropolitan Museum of Art
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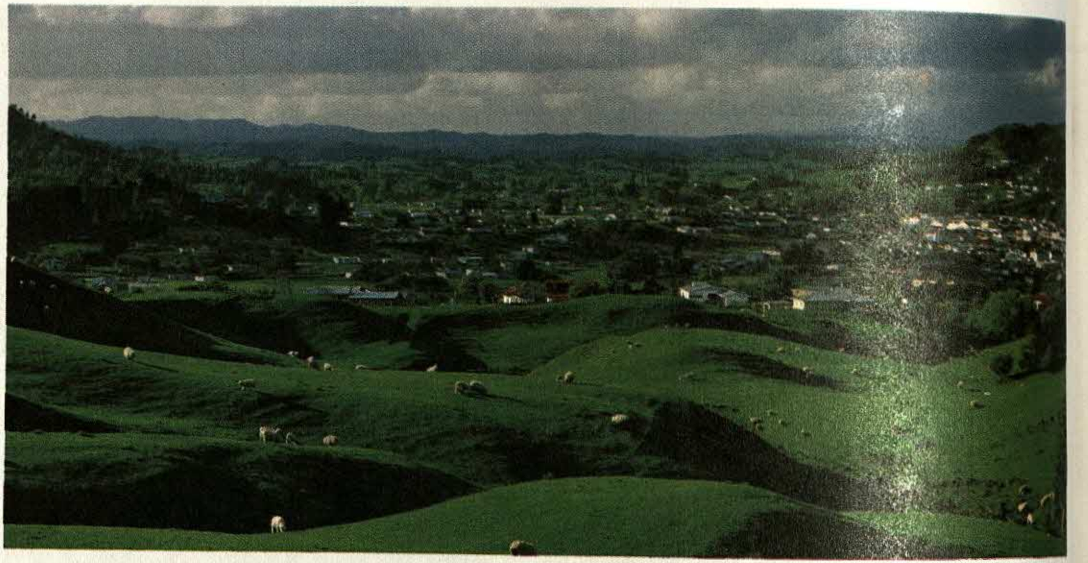
Staten Island
Statue of Liberty
Wall Street



Bill Noel Kleeman, Tom Stack & Associates

New Zealand's beautiful countryside provides excellent grazing land for millions of sheep. The nation ranks as one of the world's leading producers of lamb, mutton, and wool.

New Zealand

New Zealand is an island country in the Southwest Pacific Ocean. It lies about 1,600 kilometres southeast of Australia, its nearest continental neighbour. New Zealand belongs to *Polynesia,* a large island group. It is the largest in area of the Polynesian island countries.

The country consists of two main islands—the North Island and the South Island—and several dozen much smaller islands. Most of the smaller islands are hundreds of kilometres from the main ones. Wellington is the capital of New Zealand, and Auckland is the largest city. The country was once part of the British Empire. Today, it is an independent member of the Commonwealth of Nations, an association of countries that replaced the empire.

New Zealand is a beautiful country of snow-capped mountains, green lowlands, beaches, and many lakes and waterfalls. No place is more than 130 kilometres from the coast, and in few places are mountains or hills out of view.

A brown-skinned people called *Maori* were the first people to live in New Zealand. They came from Polynesian islands northeast of New Zealand. It is thought the first Maori settled in New Zealand as long ago as the A.D. 900's and maybe earlier. Europeans first visited the country in 1642, but they did not start to settle in the islands until the late 1700's.

Today, most New Zealanders are descendants of early European settlers who arrived in the country in the 1800's. These settlers came mainly from Britain. About 15 per cent of the people of New Zealand have Maori ancestry. They make up the largest minority in the country. A New Zealander of European descent is known as a *Pakeha.* Pakeha is the Maori word for *a stranger* or *a foreigner.* See **New Zealand, History of.**

New Zealanders have a high standard of living. For many years, the country's economy depended largely on agriculture. Today, agriculture, manufacturing, and service industries are all important to the economy. New Zealand's economy depends on trade with many countries. These countries include Australia, Japan, the United Kingdom, and the United States. Meat, fruit, and dairy products are among New Zealand's chief exports.

New Zealand has a long tradition of equal rights and benefits for all its citizens. In 1893, it became the first nation in the world to give women the vote. New Zealand was among the first countries to provide social security benefits and old-age pensions for its people. It has one of the world's finest public health services.

Facts in brief about New Zealand

Capital: Wellington.
Official languages: English and Maori.
Area: 270,534 km². *North Island*—114,592 km²; *South Island*—152,719 km². The North and the South islands extend in a curve more than 1,600 km long. *Coastline*—about 5,150 km.
Elevation: *Highest*—Mount Cook, 3,764 m above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 1996 population*—3,583,000; density, 13 people per km²; distribution, 84 per cent urban, 16 per cent rural. *1991 census*—3,434,949. *Estimated 2001 population*—3,739,000.
Chief products: *Agriculture*—apples, barley, cattle, kiwi fruit, milk, onions, potatoes, sheep, wheat, wool. *Forestry*—Douglas fir, radiata pine. *Manufacturing*—beef, mutton and lamb, butter, cheese, dried milk products, chemicals, iron and steel, machinery, motor vehicles, paper, textiles, wood products.
Anthems: "God Defend New Zealand" (national); "God Save the Queen" (royal).
Money: *Currency unit*—New Zealand dollar. One dollar = 100 cents.

Government

New Zealand is a constitutional monarchy. The nation recognizes Queen Elizabeth II of Britain as its monarch. The queen appoints a governor general to represent her in New Zealand, but the governor general has little real power. The New Zealand legislature and the prime minister and the Cabinet run the government.

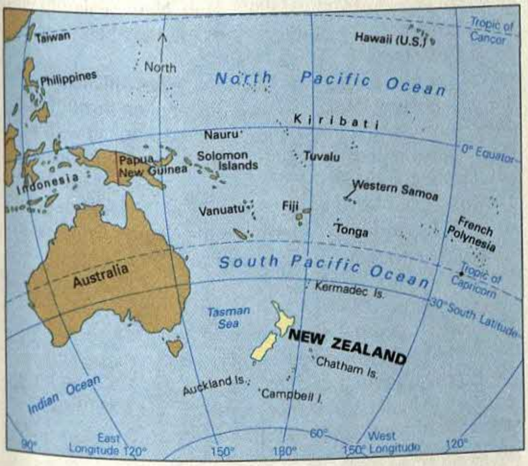
Britain gave New Zealand a constitution in 1852, when it was a British colony. Through the years, the New Zealand legislature has changed almost all its provisions.

New Zealand has no written constitution. But the 1986 Constitution Act deals with the principal constitutional components of government (the sovereign, the Executive, Parliament and the judiciary) and sets out rules for the handing over of governmental power. The 1990 Bill of Rights protects certain fundamental rights and freedoms of New Zealand citizens.

Legislature of New Zealand consists of only one house, the 99-member House of Representatives, also called Parliament. The people in each of 99 *electorates* (voting districts) elect one member of Parliament. Four electorates are reserved for Maori candidates and voters, but a Maori who wishes to do so may vote in a general electorate. A Maori may also be a candidate in a general electorate. A parliamentary election must be held at least every three years, but one may be held sooner. All citizens 18 years old or older may vote.

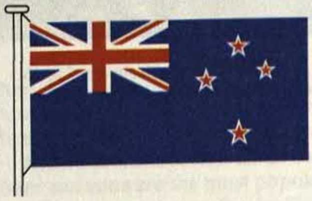
Prime minister and Cabinet. The leader of the political party that wins the most seats in a parliamentary election becomes prime minister. The prime minister appoints a Cabinet to run the various government departments. The Cabinet members, called *ministers,* are members of Parliament from the prime minister's party. The prime minister and the Cabinet are called the *Government.* The party that wins the second most seats in an election is called the *Opposition.*

The Government proposes most new legislation to Parliament. If Parliament votes in favour of a bill, then the bill becomes law. But if the Government loses the support of the majority in Parliament on an important issue, it resigns. Parliament is then dissolved, and a new election is held.

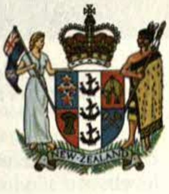


New Zealand lies in the Southwest Pacific Ocean about 1,600 kilometres southeast of Australia. The two nations are separated by the Tasman Sea.

The Parliament buildings of New Zealand are in Wellington. The offices of government ministers are located in the circular building, called the *Beehive.*



New Zealand's flag, officially adopted in 1902, features the British Union Flag and the constellation Southern Cross.



Coat of arms. The symbols on the shield represent the importance of farming, mining, and trade to New Zealand.

Political parties. The main political parties in New Zealand are the Labour Party and the National Party. There is no clear division between the policies of the two parties. Traditionally, the Labour Party has favoured government control and public regulation of industry, and the National Party has favoured free enterprise. Since 1984, however, both the Labour government and the National government which succeeded it in 1990 have adopted strong market economy policies.

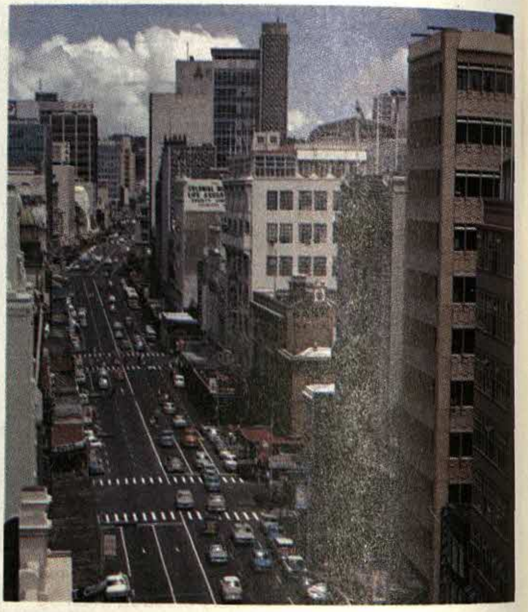
Ombudsman is an official selected by Parliament to investigate complaints by New Zealand citizens against government departments and related organizations, and local authorities. The ombudsman looks into the complaints and sends an opinion to the department involved. If the department does not take the action that the ombudsman believes is needed, the findings may be reported to Parliament. See **Ombudsman.**

Courts. The Privy Council in Great Britain is New Zealand's highest court, followed by the Court of Appeal in New Zealand. Both these courts hear only cases that have been appealed from a lower court. The High Court is the next highest court. It handles cases involving serious offences and most appeals from district courts. District courts (the lowest courts) deal with minor matters and include family courts, which handle young people and domestic disputes.

Local government in New Zealand was reorganized in 1989. The new structure provided for 14 elected coun-

People

New Zealand children must attend school from age 6 to 15. The country offers a free education to all students to age 19.



Central Auckland, like the business areas of other large New Zealand cities, has many modern office buildings.

cils at regional level and 73 elected councils at district level.

Armed forces. New Zealand's regular army, navy, and air force have a total of about 12,000 men and women. All military service is voluntary.

New Zealanders believe deeply in equal rights for all citizens. The Maori and Pakeha live in an atmosphere of common trust, and Maori political leaders and professional people play important roles in the life of the nation. There is general acceptance of the need for better housing, employment opportunities, and education for the Maori. Some Maori leaders believe the Maori should play a greater role in the government of New Zealand.

For many years, the Maori and the Pakeha have been involved in disagreements over property rights. Since the late 1800's, the Pakeha have obtained possession of most of New Zealand's land. Increasing numbers of Maori believe that the Pakeha have ignored the terms of the 1840 Treaty of Waitangi. The treaty guaranteed Maori ownership of New Zealand's land and natural resources in return for British sovereignty over the country. Some Maori groups—including a political party called Mana Motuhake—are trying to renew the terms of the Treaty of Waitangi to support Maori claims of land ownership.

The New Zealand way of life combines an easy informality with a British and Polynesian sense of politeness. In the past, many New Zealanders have kept close emotional ties to Britain, and many New Zealand customs resemble British customs. But New Zealand has developed a feeling of national identity as a Pacific nation of both British and Polynesian heritage.

Ancestry and population. For New Zealand's total population, see the *Facts in brief* table with this article. About 85 per cent of the country's people were born in New Zealand. Many of them are descendants of British settlers who came to the country during the 1800's. Immigrants still come to New Zealand, chiefly from Britain, Australia, the Pacific Islands, and other English-speaking countries.

More than 500,000 New Zealanders claim Maori ancestry. These people make up New Zealand's largest minority group. The Maori are a Polynesian people. The ancestors of these people came to New Zealand hundreds of years ago.

About three-quarters of all New Zealanders live on the North Island, and more than four-fifths of the country's people live in urban areas. New Zealand has five urban areas with more than 100,000 people. They are, in order of size, Auckland; Wellington, New Zealand's capital; Christchurch; Hamilton; and Dunedin. See **Auckland; Christchurch; Wellington.**

Language. English and Maori are the official languages of New Zealand. English is spoken throughout the country. Most of the people speak English with a New Zealand accent, which resembles a British accent with a slightly nasal sound. Since 1987, Maori has been recognized as New Zealand's other official language. The Maori language belongs to the Malayo-Polynesian group of languages (see **Language** [Other language families]).

Way of life. The people of New Zealand have a high standard of living. They have long been among the best-fed people in the world. They also receive excellent health care under a system of part-charges based on income. Medical care for accident cases is free. About 70 per cent of New Zealand families own their homes, and almost every family has at least one car.

Most New Zealanders live in single-family houses with enough land for small flower or vegetable gardens. In the larger cities, some people live in high-rise flats.

Almost all New Zealand homes have refrigerators, washing machines, and other modern electrical appliances. But few homes have air conditioning or central heating because New Zealand's weather rarely becomes extremely hot or extremely cold. In summer, New Zealanders open windows to keep their homes cool. In winter, they use electric heaters or open fires in grates to keep the homes warm.

Although about four-fifths of the people live in urban areas, New Zealand's cities are fairly uncrowded. Bad traffic jams seldom occur, even in the city centres. New Zealand's large cities have excellent restaurants as well as many milk bars and *pubs* (taverns). These cities also have theatres, concert halls, and other places of entertainment. City life in New Zealand tends to be rather quiet. However, this is changing in the larger cities, where international as well as local tourism have increased rapidly.

Nearly a fifth of New Zealand's people live in rural areas. In some rural areas, small settlements are linked by good roads, and so social contact is easy. But in rugged country, the nearest neighbours may be many kilometres away. As a result, some farmers live almost in isolation. Most farms have electricity to provide light and to operate appliances and machinery. Many farm families run their farms with little or no hired help.

New Zealanders, like people elsewhere, enjoy watching television in the evening. Almost all New Zealand homes have TV sets. The nation has three national television networks plus a pay-TV service covering major centres.

Food and drink. New Zealanders eat more butter and meat per person than do the people of any other country. Lamb is a favourite meat. *Kumaras* (sweet potatoes) may accompany lamb and other meat dishes. A special treat used to be *toheroa* soup, made from a native green clam. The toheroa is now a protected species.

Tea is the favourite drink of most New Zealanders. Beer and wine are the most popular alcoholic beverages.

Rugby players struggle for the ball during a match in Wellington. Rugby is a favourite sport of the New Zealanders.

A woodcarving school teaches young Maori one of the chief skills of their ancestors. Maori were New Zealand's first people.

Recreation. New Zealanders love outdoor activities and sports. Many city families own small *baches* (cabins) in resort areas, where they go at weekends. The nation's mild climate all year round makes camping, hiking, hunting, and mountain climbing possible in any season. Ski areas on New Zealand's snow-capped mountains attract large numbers of skiers. Many people also enjoy cricket, rugby, swimming, and tennis (see **Cricket; Rugby football**).

Yachting along the coasts or on the lakes is a popular activity. Boating in coastal waters offers the added attraction of fishing for marlin, shark, or swordfish. Such inland waters as Lake Taupo provide trout fishing throughout the year.

Education. New Zealand offers free and secular education in state primary and secondary schools. The law requires children from 6 to 15 to attend school, but most youngsters enter school at 5. Many children under 5 attend free kindergartens or play centres. Some primary schools continue through eight years. Others teach children for only five or six years, and the children then continue their education in an intermediate school for two years.

After completing primary or intermediate school, most children go on to secondary school. Secondary school children may receive special training in agriculture, home economics, technical subjects, and a wide range of other subjects.

Some schools at all levels are operated by religious groups, especially the Roman Catholic Church. Most of these schools are part of the government-supported school system.

New Zealand's government provides school bus ser-

G. R. Roberts

A worker in a factory in Christchurch sets a pattern on spools of wool before the wool is woven into a carpet. Wool carpets and other textiles are important New Zealand products.

vices. Children who live too far from a bus route may receive instruction from the New Zealand Correspondence School in Wellington. This government-run school broadcasts daily lessons on the main radio stations and posts lessons to the students.

New Zealand has seven universities—Massey University (in Palmerston North), the Victoria University of Wellington, and the universities of Auckland, Canterbury (in Christchurch), Otago (in Dunedin), Waikato (in Hamilton), and Lincoln (near Christchurch). About 86,500 students attend the universities. The universities are open to anyone with satisfactory secondary-school grades. The government pays a proportion of the expenses of many university students. New Zealand also has seven teachers' training colleges and 24 *polytechnic institutes,* which teach applied sciences and trade and technical skills.

Religion. The major religions in various parts of New Zealand still reflect the settlement patterns and faiths of the early colonists. About 25 per cent of the people belong to the Church of England. Presbyterians make up about 18 per cent of the population. Roman Catholics account for about 15 per cent, and about 5 per cent of the people belong to the Methodist Church. Other religious groups include the Ratana and Ringatu churches of the Maori. The beliefs of these groups combine Biblical teachings with the ideas of Maori prophets.

Arts. Hundreds of years ago, the Maori developed New Zealand's first and most individual arts. Their carefully detailed woodcarvings and poetic legends created a tradition that still continues among the Maori.

Some early New Zealand Pakeha artists gained fame only after moving to England and developing their skills there. The writer Katherine Mansfield, the painter Frances Hodgkins, and the political cartoonist Sir David Low all are best known for work done in England.

New Zealand literature first gained widespread international recognition in the mid-1900's. The most important writers of the middle and late 1900's included novelists Sylvia Ashton-Warner, Janet Frame, and Keri Hulme; and the poets James Baxter and A. R. D. Fairburn. The detective stories written by New Zealand author Dame Ngaio Marsh achieved worldwide popularity.

New Zealand's major cities have art galleries and museums. In Wellington are two major national collections. The National Art Gallery of New Zealand has paintings by European and New Zealand artists. The National Museum of New Zealand has science and natural history exhibits and a section of traditional Maori art.

The New Zealand Symphony Orchestra, the country's national orchestra, is internationally known. Dame Kiri Te Kanawa, a New Zealand soprano singer, has gained international fame for her performances in opera houses worldwide. Brass bands, choirs, and Scottish bagpipe bands have been popular since the days of the early settlers. Schools and universities teach fine arts, and many communities hold annual arts festivals. Pottery created by modern New Zealand potters has attracted the attention of art lovers in other countries.

New Zealand map index

Main islands

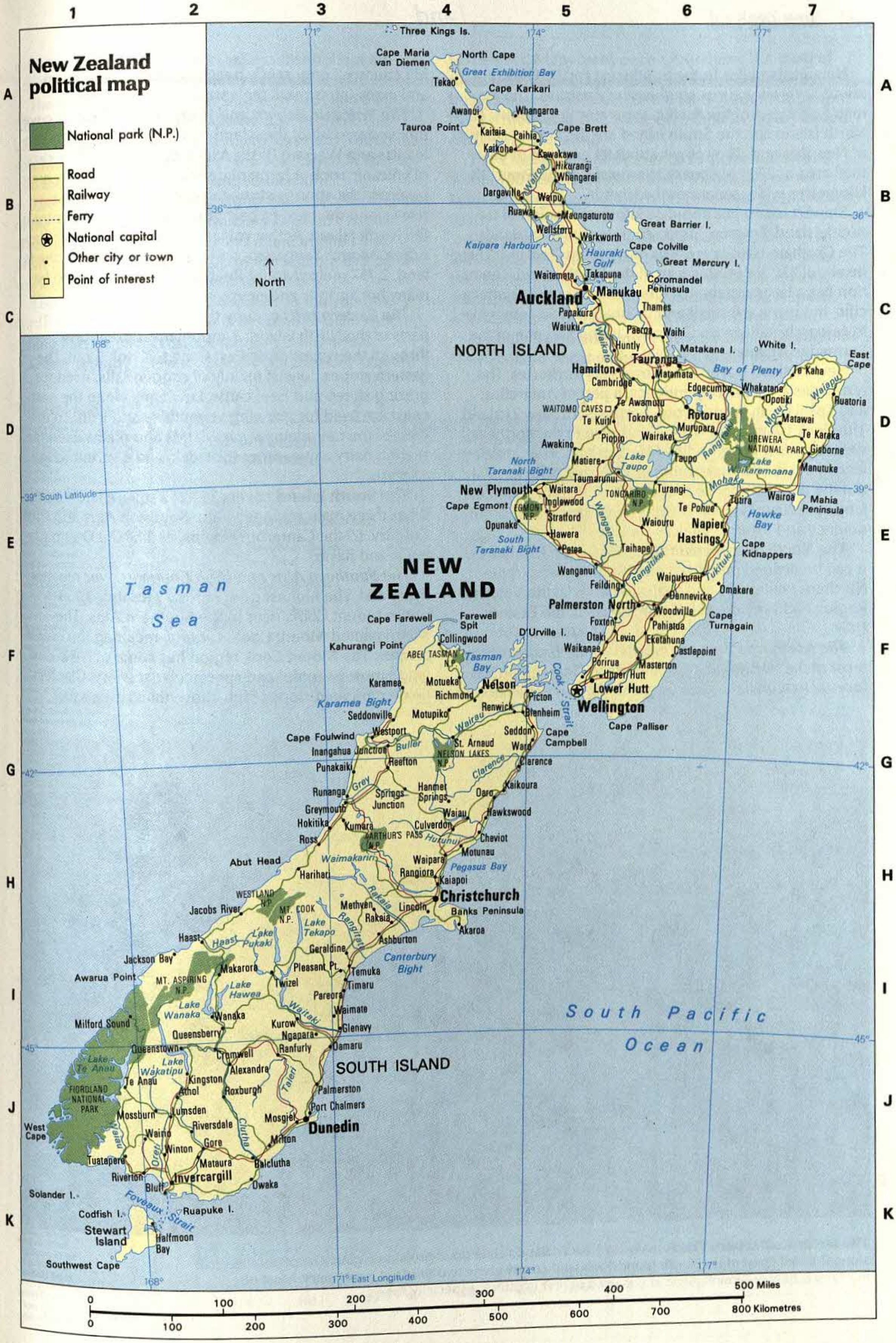
Map key	Island	Population	Area In km²
C 5	North Island	2,553,413	115,777
J 3	South Island	880,768	151,215
K 1	Stewart Island	769	1,746

Cities and towns

Alexandra	4,842	J	2
Ashburton	14,030	H	4
Ashhurst*	2,226	F	5
Auckland	855,571	C	5
Balclutha	4,227	J	3
Birkenhead*	22,582	C	5
Blenheim	23,637	G	5
Cambridge	10,145	D	5
Carterton*	3,902	F	6
Christchurch	307,179	H	4
Cromwell	3,536	I	2
Dannevirke	5,873	F	6
Dargaville	4,859	B	5
Devonport*	10,543	C	5
Dunedin	116,577	J	3
East Coast Bays*	31,325	C	5
Eastbourne*	4,494	F	5
Ellerslie*	5,681	C	5
Feilding	12,116	E	5
Gisborne	31,484	D	7
Glen Eden*	9,679	C	5
Gore	8,594	J	2
Green Island*	6,576	J	3
Greymouth	7,624	G	3
Halswell*	5,381	H	4
Hamilton	148,625	C	5
Hastings	57,748	E	6
Havelock North*	9,036	E	6
Henderson*	6,644	C	5
Heretaunga-Pinehaven*	6,094	F	5
Hokitika	3,427	G	3
Hornby*	7,738	H	4
Howick*	13,891	C	5
Huntly	6,750	C	5
Invercargill	51,984	K	2
Kaiapoi	5,234	H	4
Kaikohe	3,799	B	4
Kaitaia	5,011	A	4
Kapiti*	27,380	F	5
Kawerau*	8,311	D	6
Levin	15,368	F	5
Lower Hutt	94,540	F	5
Lyttelton*	3,200	H	4
Manukau	226,147	C	5
Marton*	5,059	E	6
Masterton	20,007	F	6
Matamata	5,701	D	6
Morrinsville*	5,281	C	6
Mosgiel	9,063	J	3
Motueka	5,052	F	4
Mount Albert*	27,579	C	5
Mount Eden*	18,877	C	5
Mount Maunganui*	12,375	C	6
Mount Roskill*	35,158	C	5
Mount Wellington*	20,397	C	5
Napier	52,468	E	6
Nelson	47,391	F	4
New Lynn*	10,498	C	5
New Plymouth	48,519	E	5
Ngaruawahia*	4,639	C	5
Northcote*	10,282	C	5
North Shore*	152,134	C	5
Oamaru	12,652	I	3
One Tree Hill*	11,165	C	5
Onehunga*	16,097	C	5
Opotiki	3,719	D	7
Otahuhu*	11,002	C	5
Otaki	4,407	F	5
Paeroa	3,661	C	6
Palmerston North	70,951	F	5
Papakura	23,357	C	5
Papatoetoe*	21,883	C	5
Petone*	8,216	F	5
Picton	4,129	F	5
Porirua	46,601	F	5
Port Chalmers	2,871	J	3
Pukekohe*	9,398	C	5
Putaruru*	4,197	D	6
Queenstown	3,659	I	2
Rangiora	6,674	H	4
Riccarton*	7,226	H	4
Richmond	7,204	F	4
Rotorua	53,702	D	6
St. Kilda*	6,201	J	3
Sockburn*	6,533	H	4
Stratford	5,528	E	5
Takapuna	69,419	C	[illegible]
Taumarunui	6,387	D	[illegible]
Taupo	15,873	D	[illegible]
Tauranga	70,803	C	[illegible]
Tawa*	12,251	F	[illegible]
Te Awamutu	8,096	D	[illegible]
Te Kuiti	4,787	D	[illegible]
Te Puke*	5,106	D	[illegible]
Temuka	3,919	J	[illegible]
Thames	6,461	C	[illegible]
Timaru	27,637	J	[illegible]
Tokoroa	17,628	D	[illegible]
Turangi	3,913	E	[illegible]
Upper Hutt	37,092	F	[illegible]
Waihi	3,679	C	[illegible]
Waikanae	6,117	F	[illegible]
Wainuiomata*	18,810	F	[illegible]
Waipukurau	3,862	E	[illegible]
Wairoa	5,094	E	[illegible]
Waitakere*	136,716	C	[illegible]
Waitara	6,482	E	[illegible]
Waitemata	96,365	C	[illegible]
Waiuku	4,357	C	[illegible]
Wanganui	41,213	E	[illegible]
Wellington	325,682	F	[illegible]
Westport	4,660	G	[illegible]
Whakatane	12,800	D	[illegible]
Whangarei	44,183	B	[illegible]

*Does not appear on the map; key shows general location.

Source: 1991 census for largest cities; 1986 census for other cities.



New Zealand political map

Land

New Zealand lies in the Southwest Pacific Ocean about 1,600 kilometres southeast of Australia. The Tasman Sea, a part of the Pacific, separates the nations. The North Island and the South Island are the largest islands of New Zealand. They cover about 99 per cent of the total area of 270,534 square kilometres. Cook Strait, 20 kilometres wide, separates the islands.

Stewart Island lies about 30 kilometres south of the South Island. Foveaux Strait separates the two islands. The Chatham Islands are also part of New Zealand. They lie about 850 kilometres east of the South Island. The nation has a large number of other islands in the South Pacific, but many are small and uninhabited. Scientists live in research stations on Campbell Island and one of the Kermadec Islands.

New Zealand governs two overseas territories. The territories are Ross Dependency, a part of Antarctica; and Tokelau, an island group northeast of New Zealand. The Cook Islands and Niue island, also to the northeast, were formerly governed by New Zealand. The Cook Islands became self-governing in 1965, and Niue in 1974. But the people of these islands are citizens of New Zealand, and New Zealand accepts some responsibility for defence and external affairs.

The North Island covers 115,777 square kilometres. It can be divided into three main land regions: (1) the Northern Peninsulas and Waikato Basin, (2) the Volcanic Region and Western Hill Country, and (3) the Eastern Hills.

The Northern Peninsulas and Waikato Basin occupy most of the northern part of the island. This region has forests, rich lowlands, citrus orchards, and undeveloped hill country. Long, sandy beaches line the west coast, and many inlets mark the east coast.

The Volcanic Region and Western Hill Country cover the western half of the island south of the Northern Peninsulas and Waikato Basin. Much of the region consists of volcanic rock. A large plateau covered with soft, grey *pumice*—the spongy stone thrown off by volcanoes—rises along the eastern part of the region in the centre of the North Island. Active volcanoes include Mount Ngauruhoe, Mount Tongariro, and the highest peak on the island, 2,797-metre Mount Ruapehu. This region also has many hot springs and geysers.

The Eastern Hills occupy the eastern and southern parts of the North Island. A mountain system runs through the region from East Cape to Cook Strait. The eastern slopes consist mainly of rugged hills, used for grazing sheep and beef cattle. Lowlands along the east coast are used for growing vegetables and fruit. To the west of the mountains are lowlands and plains used for rearing dairy cattle, other livestock, and a varied range of crops.

The South Island covers 151,215 square kilometres. It has three main regions: (1) the Southern Alps and High Country, (2) the Canterbury Plains, and (3) the Otago Plateaus and Basins.

The Southern Alps and High Country cover most of the island. The highest peak in New Zealand, 3,753-metre Mount Cook, rises in the Southern Alps. The Maori named Mount Cook *Aorangi,* meaning the *cloud piercer.* The Mount Cook region has some of New Zealand's most beautiful and spectacular scenery. Glaciers lie on mountain slopes high above thick, green for-

The fertile Canterbury Plains make up New Zealand's chief grain-growing region. The plains lie along the east coast of the South Island. Farmland covers about two-thirds of the country. Most of this land is hilly or mountainous and is used to rear livestock, especially sheep.

ests. Sparkling lakes nestle in valleys throughout the Southern Alps and High Country region.

The western slopes of the Southern Alps and High Country region are forested, rainy, and rugged. The eastern slopes are lower and much less rainy. Along the southwest coast, long inlets of the sea, called *fiords,* cut into the land. They create a jagged coastline.

The Canterbury Plains lie along the east-central coast of the South Island. They form New Zealand's largest area of flat or nearly flat land and make up the chief grain-growing region. The plains are laid out in a patchwork of fields on which cereals are grown.

The Otago Plateaus and Basins lie in the southeast corner of the South Island. It is a region of plains and rolling hills, where livestock farming is important.

Other islands. Stewart Island occupies 1,746 square kilometres. Many trees once grew there. But most of them have been cut down for timber, and scrubby bushes now cover much of the land. About 500 people live on Stewart Island. Most earn their living by fishing and oyster gathering.

The Chatham Islands cover 963 square kilometres. About 750 people, most of them Maori, live on the islands. Fishing and sheep farming are their main occupations.

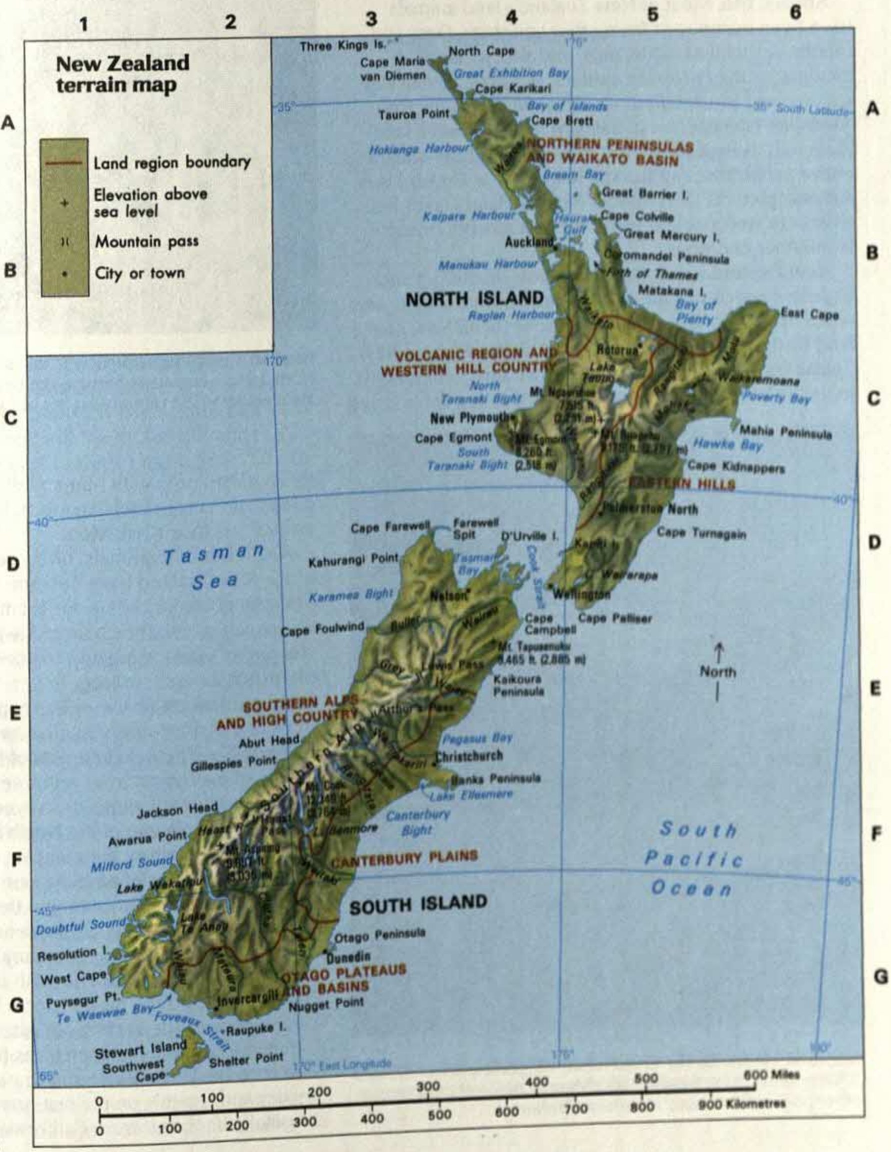
Coastline. New Zealand's coastline is about 5,150 kilometres long. Including the bays, fiords, and gulfs, the full length of the coast is about 6,920 kilometres. Auckland and Wellington, the nation's chief seaports, overlook fine natural harbours on the North Island.

Lakes, rivers, and waterfalls are found throughout New Zealand. Most of the lakes lie in the volcanic pla-

Physical features

Arthur's Pass	E	3
Banks Peninsula	F	4
Bay of Islands	A	4
Bay of Plenty	B	5
Bream Bay	A	4
Buller River	D	3
Canterbury Bight	F	3
Cape Brett	A	4
Cape Campbell	E	4
Cape Colville	B	5
Cape Egmont	C	4
Cape Farewell	D	3
Cape Foulwind	D	3
Cape Karikari	A	4
Cape Maria van Diemen	A	3
Cape Palliser	D	5
Clutha River	F	2
Cook Strait	D	4
Coromandel Peninsula	B	5
Doubtful Sound	F	1
D'Urville Island	D	4
East Cape	B	6
Firth of Thames	B	5
Foveaux Strait	G	2
Great Barrier Island	B	5
Great Exhibition Bay	A	4
Great Mercury Island	B	5
Grey River	E	3
Haast Pass	F	2
Hauraki Gulf	B	4
Hawke Bay	C	5
Hokianga Harbour	A	3
Kaikoura Peninsula	E	4
Kaipara Harbour	B	4
Kapiti Island	D	4
Karamea Bight	D	3
Lake Benmore	F	3
Lake Ellesmere	F	3
Lake Taupo	C	5
Lake Te Anau	F	2
Lake Wairarapa	D	4
Lake Wakatipu	F	2
Lewis Pass	E	3
Mahia Peninsula	C	6
Manukau Harbour	B	4
Matakana Island	B	5
Milford Sound	F	1
Mt. Aspiring	F	2
Mt. Cook	F	3
Mt. Egmont	C	4
Mt. Ngauruhoe	C	4
Mt. Ruapehu	C	5
Mt. Tapuaenuku	E	4
Mt. Tongariro*	C	4
North Cape	A	4
North Island	B	4
North Taranaki Bight	C	4
Otago Peninsula	G	3
Pegasus Bay	E	4
Poverty Bay	C	6
Raglan Harbour	B	4
Rangitata River	F	3
Rangitikei River	D	5
Raupuke Island	G	2
Resolution Island	G	1
South Island	F	3
South Taranaki Bight	C	4
Southern Alps (mountains)	E	3
Southwest Cape	G	1
Stewart Island	G	2
Tasman Bay	D	4
Tasman Sea	D	2
Te Waewae Bay	G	1
Three Kings Islands	A	3
Waiau River	E	4
Waiau River	G	2
Waikato River	B	5
Wairau River	D	4
Waitaki River	F	3
Wanganui River	C	4
West Cape	G	1

*Does not appear on map; key shows general location.



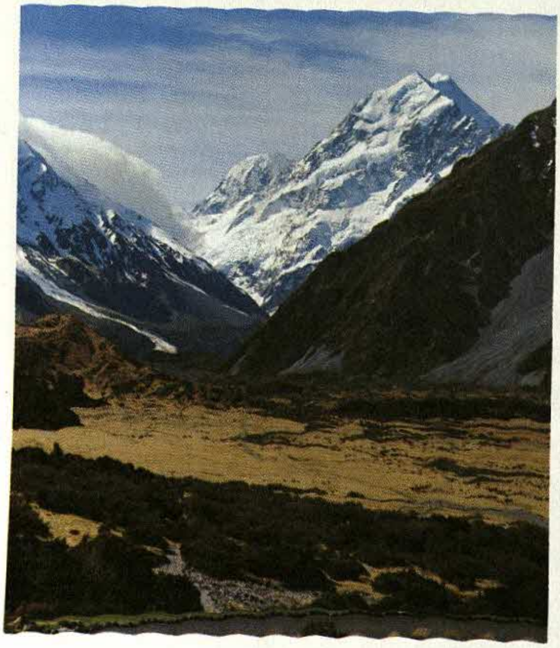
teau of the North Island and in glacial valleys near the Southern Alps of the South Island. The largest lake, Lake Taupo on the North Island, covers 606 square kilometres and is a holiday area famous for trout fishing.

On both islands, the rivers rise in the mountains and flow down to the sea. Most of the rivers flow very fast and are difficult to navigate. The Waikato River on the North Island is New Zealand's longest river, flowing 425 kilometres. The Clutha River on the South Island carries the largest volume of water. The rapid flow of New Zealand's rivers makes them important sources of hydroelectric power.

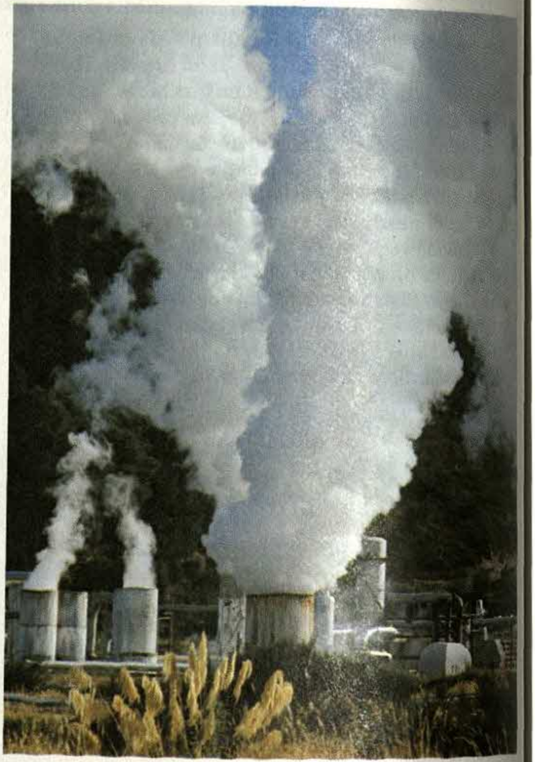
New Zealand has hundreds of waterfalls. Sutherland Falls tumbles 580 metres down a mountain near Milford Sound on the South Island. It is the fifth highest waterfall in the world.

Animal life. Most of New Zealand's land animals have been introduced from other countries. Deer and rabbits—as well as cattle, pigs, and sheep—were all brought by the European settlers. *Wallabies* (small kangaroos) and brush-tailed possums were brought from Australia. Two species of bats are the only native land mammals. New Zealand has no snakes. But the tuatara, a native prehistoric reptile, still lives in New Zealand (see **Animal** [picture: The tuatara]). New Zealand's lakes and rivers are well stocked with salmon and trout brought from other countries.

New Zealand has many native birds, including such flightless species as the kakapo parrot, kiwi, takahe, and weka. The kiwi may be the best known of all New Zealand birds, partly because *Kiwi* is a nickname for a New Zealander. The kiwi is the only known bird with nostrils in the tip of its bill. The kea, a parrot that can fly, is noted for its playfulness with human beings. New Zealand once had many ostrichlike moas, but they have become extinct. See **Kea; Kiwi; Moa.**



Majestic Mount Cook, New Zealand's highest mountain, soars 3,764 metres on the South Island. Mount Cook and hundreds of other peaks attract many mountain climbers.



Natural steam rises from a volcanic plateau in the centre of the North Island. Engineers harness the *geothermal steam* to generate electricity. The region also has geysers and hot springs.

A number of mammals, birds, reptiles, and amphibians in New Zealand have become endangered. The draining of marshy areas, for example, has threatened birds such as the little spotted kiwi and the kakapo. The clearing of land for grazing has seriously reduced animals such as Archeys frog, the gecko, and the short-tailed rat. The country now has regulations protecting all but a few of the country's native species.

Plant life. The native forests of New Zealand consist mainly of evergreen trees and tree ferns. Volcanic eruptions in prehistoric times destroyed large areas of forest in the central plateau of the North Island. As a result, small shrubs, such as the manuka, now cover much of the region. Forests of pinelike kauri trees once thrived on the Northland Peninsula, but the early European settlers cut down so many of the trees that they almost destroyed the kauri forests. Yet many evergreen trees, including some kauris, still flourish in parts of both the North Island and the South Island. Beech forests grow on the cooler uplands of both islands.

Since 1900, many foreign trees have been introduced into New Zealand. The country's pulp and paper industry depends mainly on the fast-growing radiata pine, originally imported from California.

Climate

New Zealand has a mild, moist climate like that of the Pacific Northwest Coast of the United States. But New Zealand lies south of the equator, and so its seasons are opposite to those of the Northern Hemisphere. July is New Zealand's coldest month, and January and February are its warmest months.

New Zealand's mild climate results from ocean breezes that bring warmth to the land in winter and coolness in summer. Summer temperatures range from about 18° C to 29° C. Winter temperatures range from about 2° C to about 13° C. Rain falls throughout the year in New Zealand. The amount varies little from month to month, but some regions regularly receive much more rain than others. Throughout New Zealand, the weather shifts suddenly from sunny to rainy and back to sunny again.

Climate regions. Although New Zealand overall has a mild, rainy climate, the climate differs in various parts of the country. On the North Island, the northern tip of the Northland Peninsula is warm and humid all year. But the island's central plateau has hot, sunny weather in summer and sharp frosts with occasional snow in winter. Wellington lies exposed to the frequent gales of Cook Strait. On the South Island, the rainy west contrasts with the drier east. Southern New Zealand is cooler than northern New Zealand. In mountain regions, temperatures are cooler by about 2° C with each 300-metre increase in altitude. The interiors of both islands have cooler winters and warmer summers than the coastal regions.

Rainfall. The mountains chiefly control the distribution of rainfall in New Zealand. Winds from the west carry moisture from the ocean. This moisture falls as rain on the western slopes of the mountain ranges. Almost the entire west coast averages more than 250 centimetres of rain a year. Milford Sound, located on the South Island, receives up to 760 centimetres of rain each year.

East of the mountains, the winds have lost most of their moisture. Some eastern regions of the country average less than 51 centimetres of rain a year. Severe thunderstorms rarely occur in New Zealand. Snow seldom falls in lowland areas, though some mountain peaks remain snow-capped all year.

Earthquakes. New Zealand has about 400 earthquakes every year, but only about 100 of them are strong enough to be felt. The country's most disastrous earthquake occurred in Hawke Bay in 1931. It killed 255 people and badly damaged the cities of Hastings and Napier.

Average monthly weather

Auckland				**Christchurch**			
	Temperatures C°		**Days of rain or snow**		**Temperatures C°**		**Days of rain or snow**
	High	**Low**			**High**	**Low**	
Jan.	26	12	10	Jan.	30	5	10
Feb.	26	12	10	Feb.	28	5	8
Mar.	25	11	11	Mar.	27	3	9
Apr.	23	8	14	Apr.	24	1	10
May	19	6	19	May	21	−2	12
June	17	4	19	June	17	−3	13
July	17	3	21	July	16	−3	13
Aug.	17	4	19	Aug.	18	−3	11
Sept.	18	5	17	Sept.	21	−1	10
Oct.	20	7	16	Oct.	24	0	10
Nov.	23	8	15	Nov.	26	2	10
Dec.	24	10	12	Dec.	29	4	10

Source: Meteorological Office, London.

Economy

The economy of New Zealand has long depended on farming and foreign trade. The sale of butter, cheese, meat, and wool to other countries provides much of the nation's income. But manufacturing has been increasing rapidly, and about twice as many New Zealanders work in factories as on farms. Tourism has also become an important source of income.

Natural resources. New Zealand's greatest natural resource is its land. About 53 per cent of the land consists of cropland and pastureland. About 28 per cent is covered with forests that provide valuable timber as well as giving protection from erosion. The remaining 20 per cent consists of lakes, rivers, and mountains.

New Zealand has few minerals. The most important include coal, oil, gold, iron ore, limestone, and natural gas.

Water power provides about 75 per cent of the nation's electricity. On the North Island, eight dams along the Waikato River are used to produce electricity. The Clutha and Waitaki rivers of the South Island have also been harnessed to provide hydroelectric power. A cable under Cook Strait carries electricity produced on the South Island to the more heavily populated North Island.

The underground steam in the volcanic area of the North Island is an important source of power. Near Wairakei, engineers have drilled many deep holes to release *geothermal steam.* The rising steam powers machinery that generates the country's electricity.

Agriculture. New Zealand produces enough meat and dairy products to feed its own people as well as millions of people in other countries. The high farm production results from the country's mild climate throughout the year and the use of modern machinery and scientific farming methods. Agricultural products provide New Zealand's main export revenue.

New Zealand has about 58 million sheep and more than 8 million cattle. It has about 20 times as many farm animals as people. No other country has so many farm animals in relation to its population. Sheep are so numerous that a distant hillside may resemble a field of cotton because so many fluffy white sheep are grazing there.

Sheep are reared both for meat—lamb and mutton—and for wool. Other products obtained from sheep include sausage *casings* (coverings), sheepskins, and *tallow* (animal fat). Sheep are reared on both the North Island and the South Island.

New Zealand has about 3.5 million dairy cows and about 4½ million beef cattle. Milk accounts for an important share of the nation's income. Most of the country's dairy and beef cattle are reared on the North Island. New Zealand farms also produce chickens and eggs, deer, goats, and pigs.

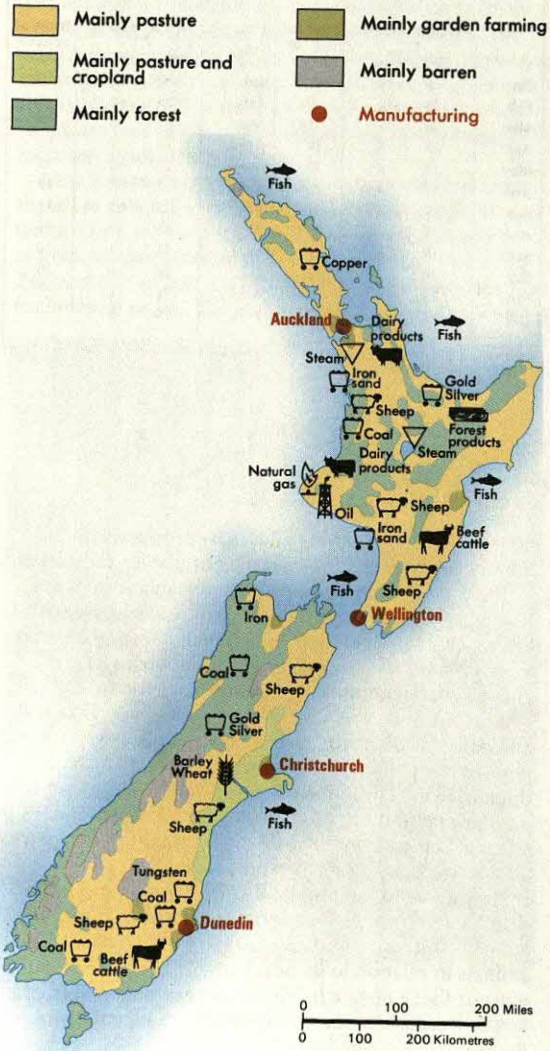
The country's chief crops include barley, potatoes, and wheat. New Zealand is the world's largest producer of kiwi fruit. Farmers also grow apples, grapes, onions, peas, and pears. Citrus fruit, avocados, and a wide variety of other subtropical fruit are grown in northern areas of the North Island.

Manufacturing. Processed foods are New Zealand's most valuable manufactured goods. Milk is made into butter, cheese, and dried milk. Factories freeze lamb and beef for export, and process wool and weave woollen carpets.

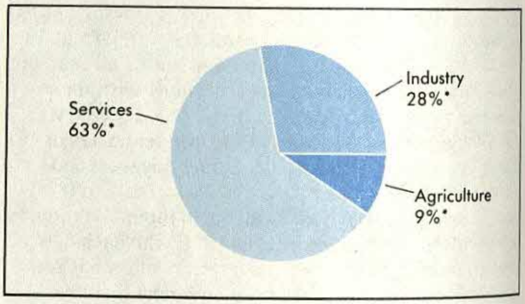
Other manufactured items include aluminium, chemicals, iron and steel, machinery, metal products, motor vehicles, paper, petroleum products, textiles, and wood products. Auckland is the country's largest manufacturing centre.

Agriculture and industry in New Zealand

This map shows how New Zealand uses its natural resources. Agriculture is the nation's chief economic activity and the source of most of its raw materials. Most of the land serves as pastures for sheep and cattle. Hydroelectric plants provide most of the nation's power. *Geothermal* power (underground steam) is an important source of electricity.



New Zealand's gross domestic product



New Zealand's gross domestic product (GDP) was 39,823,380,000 U.S. dollars in 1990. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, property, and business services; trade and hotels; transportation and communication; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture and forestry.

Production and workers by economic activities

Economic activities	Per cent of GDP produced	Employed workers	
		Number of persons	Per cent of total
Manufacturing	21	252,180	21
Trade & hotels	18	284,157	23.6
Community, government, & personal services	17	298,000	24
Finance, insurance, property, & business services	16	138,200	11
Transportation & communication	10	88,151	7.3
Agriculture	7	17,912	1.5
Construction	6	87,136	7.2
Utilities	3	13,657	1.1
Forestry	3	5,881	0.5
Mining	1	4,240	0.4
Total	100	1,203,434	100

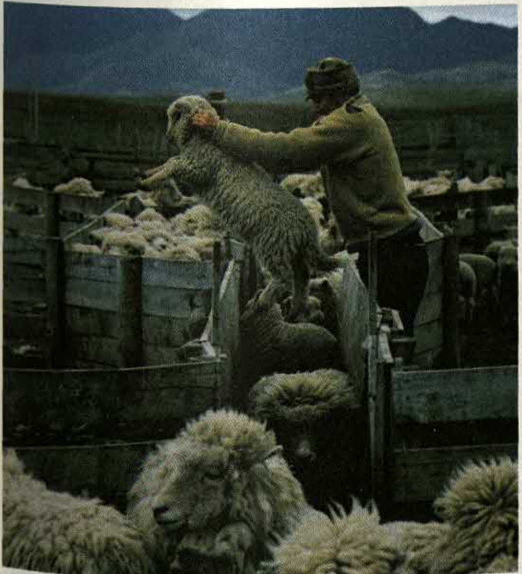
*Less than one-half of one per cent.
Figures are for 1990.
Sources: Department of Statistics, Wellington; (Official Yearbook 1992).

Forestry. New Zealand loggers cut down more than 13,306,000 cubic metres of timber yearly. About 97 per cent of it comes from plantation forests. Most of this timber comes from the radiata pine, which grows mainly on the North Island's volcanic plateau. Douglas fir is the second most important timber tree. Native evergreen trees provide less than 4 per cent of the country's timber. The most important of these trees is the pinelike rimu.

Fishing industry. The chief fish caught in New Zealand's waters include barracuda, hoki, orange roughy, red cod, and snapper. Rock lobsters are trapped along many parts of the New Zealand coast. Fresh and frozen fish and rock lobster tails rank as important exports. In addition, oyster farming is growing in economic importance.

Trade. New Zealand's economy depends heavily on trade. The country's chief trade partners are Australia, Great Britain and other member states of the European Community, Japan, and the United States. Butter, cheese, dried milk products, lamb, and wool make up about half of the value of New Zealand's exports. Efforts have been made to increase the variety of exports, with less dependence on pastoral products. Exports of increasing importance include manufactured goods, fish products, and forest products. The country's chief imports include iron and steel, machinery, motor vehicles, petroleum, scientific instruments, and electronic equipment.

Transportation and communication. New Zealand has an excellent road network. Almost all New Zealand families own a car. A railway system links the main cities. Air New Zealand provides international and domestic air services. Ansett New Zealand also provides domestic air services. International airports are at Auckland, Christchurch, and Wellington. Ferries carry passengers, cars, and railway wagons between the North Island and the South Island. Auckland and Wellington overlook fine natural harbours and have the nation's busiest seaports. Lyttelton, near Christchurch, is a major port on the South Island.



Sheep, New Zealand's most important farm animals, are reared for meat and wool. This rancher on the South Island is separating a flock into groups for fattening and shearing.

New Zealand has about 29 daily newspapers. Auckland's *New Zealand Herald* has the largest circulation among the nation's newspapers. Almost every New Zealand family owns a television set and one or more radios. Very few households are without a telephone. Postal services are operated by a state-owned enterprise, New Zealand Post. Two privately managed organizations compete to operate New Zealand's telephone and telegraph services.

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Sheep
Southeast Asia Treaty Organization
Tasman Sea

Outline

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  F. Trade
  G. Transportation and communication

Questions

Who were the first people to live in New Zealand?
What is New Zealand's greatest natural resource?
What is an *ombudsman*?
What flightless birds are native to New Zealand?
How do most people on Stewart Island earn a living?
What were the terms of the Treaty of Waitangi?
What are New Zealand's chief farm animals?
What is New Zealand's largest manufacturing centre?
Who was the first European to sight New Zealand?

New Zealand's history spans more than a thousand years. Maori, *left,* were the first inhabitants. Missionaries, *centre,* arrived in the 1800's. Modern New Zealand, *right,* is an independent nation.

History of New Zealand

New Zealand, History of. New Zealand was so named by an unknown Dutch mapmaker, after the Dutch navigator Abel Tasman visited the region in 1642. Tasman was the first European known to have visited New Zealand. But the land had been discovered and settled a thousand years earlier by people from eastern Polynesia, perhaps the Cook Islands or Tahiti. In the mid-1800's, descendants of these people adopted the name *Maori,* from their phrase *tangata maori* (ordinary person), to distinguish themselves from the *Pakeha* (European) strangers—the British settlers then colonizing the country. The Maori called their country *Aotearoa,* meaning *the land of the long white cloud,* which some Maori said was the name first used by Kupe, the legendary discoverer of the land.

In effect, the country has two histories. One is that of Aotearoa, where the Maori lived for a thousand years, largely isolated from the rest of Polynesia and out of contact with the world. The other is that of New Zealand, which, during the last 200 years, has been under European influence. New Zealand became a British colony in 1840, a self-governing dominion within the British Empire in 1907, and finally, an independent nation.

The founding of Aotearoa

It is impossible to work out an accurate *chronology* (series of dates) for the pre-European history of New Zealand. In the early 1900's, S. Percy Smith, a New Zealand scholar, devised a chronology by averaging *genealogies* (family trees) collected from Maori tribal elders. He claimed that New Zealand had been discovered by Kupe in A.D. 950, rediscovered and settled by the legendary sailor Toi and his grandson Whatonga in 1150, and finally colonized by Maori arriving in a great fleet of canoes in 1350. Until recently, Smith's chronology was included in every history of New Zealand. But it is now recognized that his averaging method was not accurate and that genealogies, even when cross-checked, are an unreliable means of dating. Many historians now believe that the great fleet was merely the creation of a fertile European imagination, though different Maori tribes retain traditions of individual founding canoes.

Because spoken history cannot provide reliable dates, some scholars have used archaeology to aid them in their investigation of the history of the country. A scientific method called *radiocarbon dating* has been used to provide reasonably accurate dates for the remains of *middens* (piles of kitchen waste, such as shells left behind after eating). Radiocarbon dates of middens have shown that settlement occurred in New Zealand by A.D. 800, but it is unlikely that such early middens represent the sites of first occupation. Although the Maori population of New Zealand in the late 1700's could have descended from one canoe-load of Polynesians who arrived about 800, it is unlikely that there was only one such voyage. There were probably several arrivals to the country, either accidental or deliberate. It is even possible that there were some two-way voyages—at least before the 1300's, when climatic changes made such voyaging increasingly dangerous. The fact that the Maori successfully transported to New Zealand several garden crops, including *kumara* (sweet potatoes), *taro* (another root crop), and yams, as well as dogs, if not pigs or fowls, is evidence of deliberation in their voyaging. Nevertheless, the evidence is consistent with the theory of an early arrival of small numbers of East Polynesians followed by a period of little contact. According to the New Zealand archaeologist Janet Davidson, it might have taken about 400 years for an original population of 100 people to have expanded to a population of 5,000. But afterward, the growth would have been more rapid, with the total population reaching an estimated 125,000 by the late 1700's. The greater part of the early population was concentrated in the warmer, coastal areas of the North Island. The period from 1300 to 1500 has been seen as one of considerable expansion in the north, accompanied by vigorous warfare. For more detailed information, see **Maori.**

European discovery and settlement (1642-1840)

Tasman and the Dutch. Abel Tasman's voyage of 1642 was designed by the Dutch East India Company to fulfil several goals: to find the limits of the great southern continent; to discover new riches; and to open a

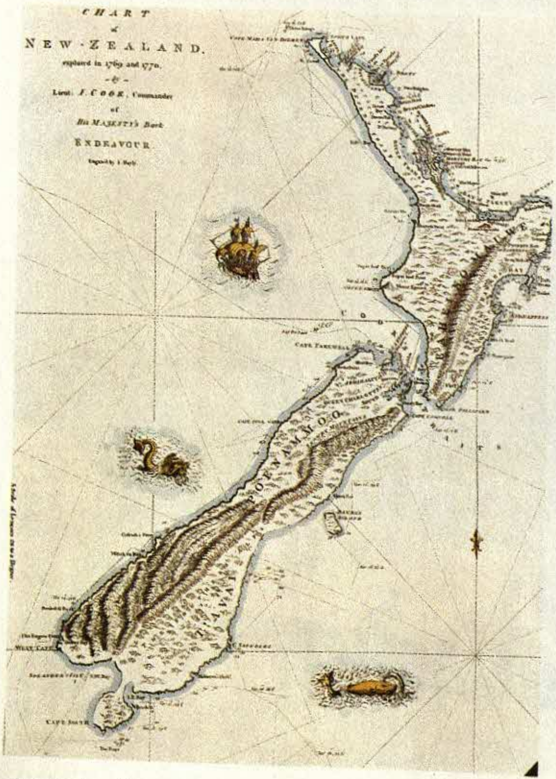
Maori villages were fenced off for protection. The Maori grew *kumara* (sweet potatoes) and *taro* (a root vegetable).

The Maori lived in New Zealand some thousand years before Europeans arrived. They called the land *Aotearoa*, which means *the land of the long white cloud.*

route through the southern ocean to Chile. Tasman sailed south of the Great Australian Bight, touched on the south coast of Van Diemen's Land (now Tasmania), and on December 13, came in sight of "a great land uplifted high" (Southern Alps). He sailed northward along the coast, anchored in a large open bay, and made contact with the inhabitants. But the next day, four of his men were killed when some Maori attacked a boat. Tasman described the event as "an outrageous and detestable crime." His ships opened fire and moved northward. But Tasman did not land. He left an incomplete chart of what he called *Staten Landt,* but he had failed to demonstrate that it was part of a southern continent, let alone a source of valuable trade. He reported that the land was peopled by dangerous "savages," and was therefore best left alone. See **Tasman, Abel.**

Cook's voyages. New Zealand was left alone for 127 years after Tasman's voyage. Then, in 1769, Captain James Cook, heading a British expedition to Tahiti to examine the transit of Venus across the face of the sun, came south to investigate Tasman's discovery. Cook treated the Maori with caution. But he was involved in violent confrontations with them from his first landfall at Turanga in Poverty Bay. Cook sailed round the two main islands and accurately placed New Zealand on the map, proving that it was not part of a southern continent.

He recommended the place he called *Thames* as a site for a colony and claimed New Zealand for Britain. Cook's favourable views of New Zealand and its people were hardly changed during later visits, despite the killing of a boat's crew in Queen Charlotte's Sound in 1772. See **Cook, James.**



Detailed and accurate maps of the New Zealand islands were made by James Cook, a British navigator.

Abel Tasman, a Dutch explorer, was the first European known to visit New Zealand.

French interest. The French, who came to New Zealand after Cook, were involved in even more dramatic conflicts with the Maori. Jean François De Surville anchored in Doubtless Bay in December 1769, just after Cook had passed by. De Surville had a dispute with the Maori and sailed off with a captive hostage. Marion Du Fresne, who spent five weeks at the Bay of Islands in 1772, quarrelled frequently with the Maori he met before he was killed along with 24 of his crew. The French survivors gathered their forces and retaliated, killing at least 300 Maori. The death of Du Fresne, who had had a naive trust in Maori as a group of *noble savages,* shocked Europeans and warned them off New Zealand. They did not resume contact for 20 years.

Commerce and Christianity. When European contacts were resumed with New Zealand, they came largely from the British convict settlement at Sydney. In the 1790's, Australian settlers began deep-sea whaling and sealing off the New Zealand coast. In addition, cargoes of spars and flax were taken from Hauraki Gulf in 1794 and 1795. Maori people became involved in these activities, and missionaries settled in New Zealand to convert the Maori to Christianity. Increases in commerce and colonization led to conflicts between the Europeans and the Maori, and the British government moved to impose law and order in the region.

The sealing and whaling industries. In 1791, Australian settlers began deep-sea whaling off the New Zealand coast in the *William and Ann.* In 1792, the *Britannia* left a sealing gang at Dusky Sound. The gang collected more than 4,500 skins to be sold in China. British, American, and other sealers soon joined the Australians.

But the seal population could not withstand the heavy killings, and the sealing industry soon collapsed. Seal colonies were almost killed off within 20 years. One vessel alone took some 60,000 skins to Sydney in 1806. But by the 1820's and 1830's, the seal population had recovered sufficiently to support a modest harvesting.

The whaling industry lasted longer than the sealing industry. It consisted of deep-sea hunting of sperm whales and shore-based whaling for right whales. New Zealand provided ports for the whaling ships to take on fresh food and water. Whalers who hunted right whales from the shores erected buildings, established gardens, and married Maori women. Many of the first European settlements around the southern sounds and bays were established in this way, and the descendants of the settlers still live there. By 1840, there was a large township at Kororareka in the Bay of Islands, with several hundred European inhabitants of various nationalities. In the south, Johnny Jones, with seven whaling stations, employed 280 men. The Weller brothers, on the Otago peninsula, employed about 120. But during the 1840's, the whaling industry slowly declined.

The flax and timber industries also rose and fell. Early attempts to treat New Zealand flax for ropes and cordage had little success. But from 1820, there was a boom in the industry caused by the Maori demand for muskets, the chief item of exchange. The value of flax exports peaked in 1831, then fell off as the demand for muskets was satisfied. In northern ports, such as the Hokianga, there was a busy local shipbuilding industry and also a growing timber trade across the Tasman.

Maori involvement. The Maori played an energetic part in the European activities. Some became whaling crew members or laboured at the shore camps. Others became sawyers or shipwrights. Many Maori women became companions or wives of Europeans. Maori chiefs, such as Te Pahi of the Bay of Islands, often visited Sydney. They brought pigs and potatoes back to their tribes, and these items became valuable items of trade.

Occasional Maori attacks on Europeans continued to take place. The most notable occurred in 1809, when Maori attackers killed most of the crew of the *Boyd* in Whangaroa harbour. But the Maori quickly realized that violence would drive the Pakeha traders away.

The Maori were more violent toward one another than they were toward the Pakeha. Fighting was common between tribal groups, and those who first got European weapons, especially muskets, used them in attacks on their traditional enemies. For the first 20 years of the 1800's, New Zealand was the scene of bloody warfare, as first Hongi Hika and other Ngapuhi chiefs from the north, and later Te Rauparaha from the Cook Strait area, attacked less well armed communities.

The missionaries. In 1814, Samuel Marsden, chaplain to the convicts at Sydney, established an Anglican mission at Rangihoua in the Bay of Islands. He worked under the leadership of the British schoolteacher and missionary Thomas Kendall. The missionaries in New Zealand led a difficult existence for some years. They were under the control of such powerful Maori chiefs as Hongi Hika and were unable to make converts. But with the arrival of the forceful missionary Henry Wil-

Missionary settlements, such as this one at Rangihoua, in the Bay of Islands, were established in the North Island of New Zealand during the early 1800's.

liams in 1823, the mission gained effective leadership, gradually establishing more stations around the Bay of Islands. By the 1830's, the mission was beginning to make converts. In 1823, a Wesleyan mission was established at Whangaroa. But it was abandoned four years later and reestablished at Mangungu on the Hokianga Harbour. In 1838, much to the dismay of the British Protestant missionaries, a French Catholic mission was established at the Hokianga under Bishop Pompallier.

The missions continued to expand in the 1830's. The Anglicans established new stations down the east coast, while Wesleyan stations were established down the west coast. This rapid expansion indicates that the Maori were being converted to Christianity in large numbers. But, as historians have pointed out, that conversion was largely superficial and was undergone by Maori for their own reasons. One important reason was that the missions, with their monopoly on the printing press, provided the Maori with the key to literacy. Moreover, it was largely Maori converts—many of them freed slaves from other tribes—who carried Christianity from the Bay of Islands to other areas. Often, the European missionary had merely to bless a conversion already carried out. By 1840, all Maori tribes had been touched to some extent by Christianity. The schooling of the Maori in Christianity and their trust in the Protestant missionaries were to be of great significance when the British moved to take over New Zealand as a colony.

British intervention. The expansion of commerce and Christianity in New Zealand caused an increasing amount of European colonization. Shore-based whalers, traders, and missionaries formed settled communities. Missionaries usually brought wives along and were soon raising large families. The other Europeans—*Pakeha-Maoris* as they were called—often married women from local Maori communities. There was much trouble between the mission and ordinary Europeans, particularly at the Bay of Islands, where the missionaries disapproved strongly of the drunkenness and lawlessness in the whaling settlement of Kororareka. Missionaries such as Henry Williams acted as peacemakers between warring Maori tribes. But some Pakeha-Maori traders made such warfare worse by trading in muskets. A notorious case was that of a Captain Stewart, who, for a load of flax, transported Te Rauparaha and his warriors to Akaroa, where they slaughtered a hundred of the local Ngaitahu in 1830. An attempt to prosecute Stewart in Sydney failed for lack of evidence. Such incidents highlighted the need to impose law and order. Thus far, the British had maintained that New Zealand was "not within His Majesty's Dominions," as an 1817 statute put it. Although later acts of 1823 and 1827 provided that British offenders were to be tried in Sydney, that legislation was ineffective, as the Stewart case demonstrated. In 1833, James Busby was sent to the Bay of Islands to serve as British resident. But the resident had authority without power. He had neither police nor troops and had to fall back on moral persuasion. In 1835, Busby tried to bolster his authority by summoning a Maori Assembly at Waitangi. The assembly issued a Declaration of Independence and appealed for British protection. The British government recognized Maori independence and promised protection, but it soon became evident that the British could only protect the Maori by negotiating away their independence.

In the late 1830's, a large number of European colonists arrived in New Zealand, mostly from Australia. By 1840, their number had risen to about 2,000. During this time, the British government also feared French and American intervention in New Zealand. But, in fact, the main threat of intervention came from British citizens. In 1837, the colonial theorist Edward Gibbon Wakefield formed the New Zealand Association to promote British colonization of the country. In 1838, the association was transformed into the New Zealand Company. At the end of 1838, the British government decided to appoint Captain William Hobson as a consul in New Zealand, with authority to negotiate with Maori chiefs to persuade them to give up their territories. There was considerable delay in drawing up Hobson's final instructions. Before Hobson could depart, Wakefield learned about the instructions and sent out his own land-buying expedition under his brother William. To conceal his real purpose, Wakefield created a myth that his expedition was necessary to save New Zealand from the French. But he did speed up Hobson's departure. See **Wakefield, Edward Gibbon.**

Important dates

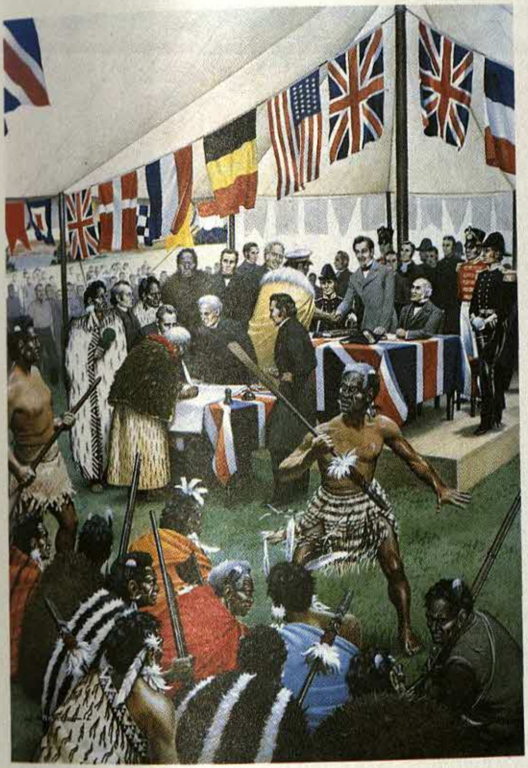
1642	Tasman visited New Zealand.
1769	Cook circumnavigated New Zealand.
1772	Du Fresne was killed at Bay of Islands.
1791	Sealing and whaling began off New Zealand coast, followed by trade in flax and timber.
1814	Marsden established a mission at Bay of Islands.
1819	Hongi Hika initiated musket wars.
1833	Busby was appointed British resident.
1835	Northern Maori chiefs signed a Declaration of Independence.
1839	Wakefield sent land-buying expedition for New Zealand Company; British government instructed Hobson to negotiate with the Maori.
1840	British annexed New Zealand.

Population

1840	Maori: about 100,000; Europeans: 2,000.

The colonial period (1840-1852)

The Treaty of Waitangi. Hobson arrived in Sydney on Jan. 29, 1840. Governor Gipps issued a proclamation that extended the boundaries of New South Wales to include New Zealand and appointed Hobson lieutenant governor. Hobson then issued a proclamation to stop the buying of land in New Zealand. He travelled to the Bay of Islands, where, with the help of Busby, he drafted a treaty between the Maori and the British government. Under its terms, the Maori *ceded* (gave up) control and authority over their lands in return for property ownership, rights as British subjects, and British protection. Henry Williams translated the treaty into Maori, and it was discussed with the Maori at Waitangi on Feb. 5, 1840. Forty-five of the Maori signed the treaty the next day. During the next few weeks, copies of the treaty were taken around the country by Hobson's officials or missionaries and were signed by some 500 Maori. Most of the chiefs of the coastal tribes signed. Most of the chiefs of the inland tribes did not. By May 21, Hobson thought he had enough signatures to proclaim British sovereignty over the North Island. But, because his messengers had not returned from the South Island and he



Maori chiefs signed the Treaty of Waitangi in 1840. The treaty made New Zealand a British colony.

was anxious about the activities of a French company at Akaroa, he declared sovereignty over the South Island on the basis of Cook's discovery. For more detailed information on the Treaty of Waitangi, see **Waitangi, Treaty of.**

Crown colony. Hobson began his administration in the Bay of Islands. But he soon shifted the seat of government to Auckland, where a thriving European settlement developed on the strip of land between the Waitemata and Manukau harbours. In 1841, a charter was issued separating New Zealand from New South Wales and constituting it a crown colony. As governor, Hobson established a small Executive Council, made up of himself and senior officials, and a Legislative Council, made up of the same people plus three nominated colonists. The colonists demanded self-government, though they were still outnumbered by the Maori.

The New Zealand Company, formed by Wakefield, was active in New Zealand during this time. In January 1840, before Hobson arrived in New Zealand or there was any news of William Wakefield's land-buying expedition, the first New Zealand Company settlers arrived at Wellington, where Wakefield claimed to have bought large areas of land. The company's title was disputed by local Maori, and the land was unsurveyed. Some of the company settlers were sent on to Wanganui. In 1841, a settlement was established at New Plymouth in Taranaki. In 1842, another company settlement was established at Nelson. In both cases, there were land disputes with the Maori. In 1843, a party of Nelson settlers, commanded by Captain Arthur Wakefield, clashed with Te Rauparaha and the Ngatitoa over land at Wairau. A total of 22 Europeans and 4 Maori were killed. Later, clashes occurred in the Hutt Valley and at Wanganui. But the land disputes were eventually resolved, more land was bought, and the colonists gradually settled on their land.

Important dates

1840	Treaty of Waitangi was signed and New Zealand was annexed as a British colony; New Zealand Company settlement was established at Wellington.
1841	Plymouth Company was established at New Plymouth.
1842	Nelson settlement was established.
1845	Northern war began.
1848	Otago settlement was established.
1850	Canterbury settlement was established.
1852	Constitution Act established a central government and six provinces.

Population

1852	Maori: about 60,000; Europeans: 30,000.

Heke's Revolt. In the mid-1840's, land troubles in the south were overshadowed by a war in the north. At the Bay of Islands, Hone Heke, the first chief to sign the Treaty of Waitangi, became disillusioned with the way in which the governor's exercise of authority was diminishing his chiefly power. He decided to destroy the symbol of the governor's authority by cutting down the flagstaff at Kororareka. He defeated the troops who were sent to protect the town, and then destroyed the town. British troops were brought in from New South Wales. Many were killed and wounded in attacking Heke's *pa* (fortified village) at Puketutu and Ohaeawai before the British gained the upper hand by capturing Ruapekapeka pa.

Colonization proceeded rapidly from the late 1840's, as offshoots of the New Zealand Company looked to the South Island. The small Maori population—about 2,000, spread along the coasts—and the large, open plains made the South Island particularly attractive to the colonists. Many farmers from Australia brought sheep to New Zealand. New Zealand Company settlers from Nelson and Wellington joined the rush. But the main push came from two new settlements established in the South Island. The Otago Association, formed by Thomas Burns and William Cargill, both elders of the Free Church of Scotland, established a settlement at Dunedin in 1848. In 1850, the Canterbury Association, formed by leading Anglicans in England, established a settlement at Christchurch.

Within 10 years, the New Zealand Company and its offshoots had established six settlements and had brought more than 15,000 colonists to New Zealand. By 1851, the European population had reached 26,707, with a third of the colonists in Auckland and other northern settlements and the rest in settlements to the south.

Constitution. In 1852, the country was granted a Constitution that recognized the scattered and diverse nature of the European settlements. It called for a central government, the *General Assembly,* made up of a *bicameral legislature* (two-house parliament). The legislature consisted of a House of Representatives, whose members were elected by men with a certain small amount of property, and a nominated Legislative Council. There were also six provincial governments—for

British soldiers attacked the *pa* (fortified village) of the rebellious northern Maori chief Hone Heke in 1845 and forced him to surrender.

Auckland, Taranaki, Wellington, Nelson, Canterbury, and Otago—each with elected superintendents and councils.

The provincial period (1852-1876)

Provincialism and colonization. The first provincial superintendents and councils were elected in 1853, a year ahead of the first General Assembly. The provincial governments thus gained an initiative over the central government that lasted 20 years. Southern politicians resented taking the perilous sea journey to Auckland for sittings of the General Assembly. Their main interest was in carving up the South Island into farms.

Most colonists were British, though a few were from continental Europe. These included Germans who went to Nelson, Scandinavians who settled in the Seventy-Mile Bush between the Wairarapa and Hawkes Bay, and Bohemians who settled at Puhoi, north of Auckland. In Taranaki, the Maori were reluctant to part with land, thus limiting further settlement.

The New Zealand Wars (1860-1872). Government attempts to buy land often divided Maori tribes into land-holding and land-selling factions. Fighting soon broke out between these groups. In north Taranaki, a feud over the Waitara block of land led to bloodshed. In 1859, the Governor of New Zealand, Colonel Gore Browne, offered to buy from the land-selling faction. The sale was resisted by a group led by Wiremu Kingi, and by the bulk of the Atiawa tribe. Military law was declared, and troops occupied the land. When Kingi's supporters resisted, war began. Other Taranaki tribes joined Kingi, as did volunteers from Waikato, where in 1858 a Maori king had been elected to halt land sales.

The fighting engulfed much of Taranaki. In 1863, it spread to Waikato when about 10,000 British and local colonial troops began a series of assaults on Maori pa along the Waikato River. The Maori fought bravely, inflicting heavy casualties on the British, particularly at Rangiriri. But after a heroic defence of Orakau, they were defeated. The fighting then spread to the Bay of Plenty when the British forces attacked the Maori king's allies at Gate pa. The British suffered a humiliating defeat there before gaining revenge at Te Ranga. This was the last major battle of the New Zealand Wars, and most of the British regiments were withdrawn.

But the conflicts were far from over, though they were mainly fought on the European side by the local colonial army and loyal Maori. The wars were prolonged by two factors. One was the confiscation of land from the rebel Maori, which provoked them into desperate resistance. The other was the appearance in 1863 of a religious cult, known as *Hau Hau,* from which the Maori drew divine inspiration to continue their struggle. Fighting continued on the west and east coasts. Then, as the Hau Hau forces were gradually worn down, the Maori cause was revived by two gifted guerilla leaders, Titokowaru in south Taranaki and Te Kooti in Poverty Bay. These leaders inflicted some stunning defeats on the colonial forces before they themselves were put on the run. The campaigns against Te Kooti took the colonial forces into the bush-clad Urewera country. Fighting continued on a small scale until 1872. Te Kooti was never captured. He eventually took refuge with the Maori king in what became known as the *King Country.*

Te Whiti, a Maori prophet, *above,* was arrested by British soldiers at his village of Parihaka, *left,* for his opposition to European settlement in Taranaki.

The king himself symbolically laid down his arms in 1881. Te Kooti was pardoned two years later. Meanwhile, much of the conquered and confiscated territory was occupied by military settlers or sold to ordinary colonists. Beyond settled areas, forts were staffed by armed constabulary. In Taranaki, 1,500 soldiers were sent to Parihaka in 1881 to arrest Te Whiti, a Maori prophet who had organized passive resistance to the occupation of confiscated land on the Waimate plains.

There were some peaceful means to colonization. In 1862, the Crown's right to buy Maori land ahead of all other buyers was abolished. Thereafter, settlers bought land directly from Maori owners named by a Native Land court. Tribes that had remained loyal through the war, such as the Ngatikahungunu of Hawkes Bay, were the first to lose their land by this process. But they were also the first to gain British rights and privileges, such as electing four Maori members to the lower house.

Wool and gold. The South Island, unaffected by the northern wars, developed rapidly. In the 1850's, the tussock country of the Canterbury plains and the foothills of the Southern Alps was rapidly taken up for pastoral runs. Merino wool provided the country with its first important exports. The pastoralists became a new *squattocracy* (class of wealthy landowners). They dominated the political and social life of the colony until their wealth was threatened by depression late in the 1800's.

In 1860, a rich alluvial goldfield was discovered in Otago by the Tasmanian prospector Gabriel Read. The province was soon invaded by eager diggers, mainly from the largely worked-out Victorian fields. From *Gabriel's Gully,* the diggers moved on to the rich lodes of central Otago. Otago was quickly transformed from a struggling Free Church settlement into the most populous and prosperous province in the colony. Canterbury also prospered, more especially with the discovery of gold on its west coast in 1864. Auckland also shared in the prosperity when gold was discovered at the Thames in 1869—though here the alluvial gold was soon worked out, and the richest lodes were found in quartz seams. The biggest profits went not to the individual diggers—soon to become mine labourers—but to the creators of mining companies. But it was not until the cyanide process was developed in the 1890's that mining in the Coromandel ranges was to have its most enduring period of prosperity. In the South Island, individual diggers were also gradually displaced by dredges used to extract the last of the alluvial gold.

Gold did not replace wool as the leading export until the 1860's. But it did bring more colonists to the country than did the New Zealand Company and its offshoots.

Gold miners at the Coromandel goldfield were depicted by the artist Charles Heaphy in 1852.

Important dates

1853	Provincial councils and superintendents were elected.
1854	General Assembly was elected.
1856	Responsible government was conceded, except for Maori affairs.
1860	Taranaki War began; gold rush began in Otago.
1863	Waikato war began.
1870	Vogel proposed immigration and public works policy.
1872	New Zealand Wars ended.
1876	Vogel abolished the provincial governments.

Population

1874	Maori: 47,330; Europeans: 297,654.

The diggers profoundly altered the social structure of the population. They eventually formed the basis of a working class, though politics continued to be dominated by the commercial and farming middle class.

Indeed, governments in the provincial period were merely shifting groups of the ruling commercial and farmer class. E. W. Stafford, a Nelson farmer, formed the first stable ministry in 1858. But it was destroyed by the New Zealand Wars in 1861. Later ministries were reshuffled as politicians squabbled over the costs and spoils of the wars. The colonial politicians tried to avoid paying the cost of British troops. Only when the British government forced the issue by withdrawing most of the troops in 1864 were the colonists prepared to accept a self-reliant ministry under Frederick Weld. Even that ministry hoped to pay the costs of war with confiscated Maori land and from British loans.

The continued war expenditures and, before long, declining returns from exhausted gold deposits, gradually affected New Zealand's economy. By 1869, the colony was entering a depression, and a bold vision was needed to set it on the road to recovery.

That vision did not come from the gentry but from an upstart, Julius Vogel, a London-born businessman. He became colonial treasurer in 1869 and, in 1870, boldly proposed to borrow 20 million New Zealand dollars overseas to promote immigration and the construction of trunk roads and railways in both islands. He hoped to repay the loans from increased revenue and by reserving crown land for future sale. It was a heady speculation that caught the imagination of the country and quickly replaced a depression with a boom. Ironically, Vogel's scheme destroyed the provinces he had originally defended. The provinces refused to set aside the reserves of land required to pay the loans, and in 1876, Vogel abolished the provincial governments.

Continuous ministry and the long depression (1876-1890)

Vogel's loan-induced boom was bound to end in a recession because it set off a bout of land speculation and did not immediately increase production. It was followed by a long depression that lasted for 20 years.

The conservative Vogel-Atkinson ministry, which had held office most of the time since 1869, was defeated in 1877 by a fragile coalition of provincialists and liberals. The coalition was led by ex-governor Sir George Grey. Though Grey introduced some constitutional reforms, including votes for all adult men and *triennial* (three-year) parliaments, he was unable to spirit away the depression. Grey survived an election, but he was defeated in the House in 1879, and the "Continuous Ministry" was reformed under Sir John Hall. His treasurer, Harry Atkinson, began a policy of cutting back on spending. But the country wanted a return to Vogel's "magic." In 1884, Vogel was able to form a new government with Sir John Stout, one of Grey's former liberals. But this time Vogel was unable to borrow New Zealand out of depression. He was involved in a land scandal, and the ministry fell in 1887. It was replaced once more by Atkinson and cutbacks.

Although the depression showed little sign of lifting, changes were already taking place that were to have long-term effects on the economy. The most notable was the introduction of refrigeration, which allowed New Zealand's primary products to be transported to Britain. In 1882, Thomas Brydone of the New Zealand and Australia Land Company arranged a shipment of frozen meat and dairy produce to Britain. The New Zealand Shipping Company began a regular shipping service with refrigerated vessels. Farmers, dependent on wool, hides, and tallow, now had a new export market in frozen mutton and beef. Dairy farmers, formerly restricted to a small local market, could now export their butter and cheese. Chains of freezing works and cooperative dairy factories owned by the farmers were built to supply the new export markets.

Important dates

1877	Grey formed a liberal ministry.
1879	Grey was defeated and Hall reformed the Continuous Ministry.
1882	First shipment of refrigerated produce was sent to Britain.
1884	Vogel formed a ministry with Stout.
1887	Atkinson reformed the Continuous Ministry.

Population

1886	Maori: 43,927; Europeans: 576,524.

The Liberal era (1890-1912)

In 1890, the election of a reorganized Liberal Party led by John Ballance began a new era in New Zealand politics. Previously, governments had been unstable coalitions of largely provincial interests. But the Liberals were to become the first nationwide political party. Though they were also a coalition, their bonds were based on class rather than on regional interests. Over 22 years, the party won a succession of elections, originally by sponsoring *radical* (basic) reforms, and later by serving rural conservatism. Their unbroken reign in office was a new development in New Zealand politics.

The party's radical reforms were confined to the first two terms in office. During this time, important constitutional reforms were made, including granting women the right to vote. A number of radical labour laws were also instituted, generated by William Pember Reeves. They included an arbitration act, which virtually eliminated strikes for more than 10 years and was to remain at the centre of New Zealand's industrial relations for most of the 1900's. The Liberal legislation gained New Zealand a reputation as a "social laboratory," and overseas observers came to study, to applaud, and only rarely to criticize.

There were also some grounds for satisfaction over race relations. Throughout the 1800's, the Maori population had been declining. But the 1901 census revealed an increase that continued uninterrupted in the 1900's.

Though the Liberals made much of their achievement in the Maori field, they also had to please their rural supporters. In the North Island, that meant acquiring Maori land for European settlement. Richard Seddon, who had beaten the radical Reeves for the premiership in 1893, soon saw that the farmers had no sympathy for the changes favoured by city people. The only notable piece of social legislation after Reeves left the government in 1894 was the Old Age Pensions Act of 1898—and even that was not much in advance of similar legislation in Europe. Seddon died in 1906. His successor, Sir Joseph Ward, lacked Seddon's popularity. An opposing Reform Party, led vigorously by William Fergusson Massey, gained power in 1912.

Important dates

1890	Liberals won the election.
1893	Votes for women were granted.
1898	Old Age Pensions Act was passed.
1912	Reform government was elected to office.

Population

1911 Maori: 52,723; Europeans: 1,005,585.

The Reform and United eras (1912-1935)

World War I (1914-1918). In 1912, Massey captured power because he had gained the support of most rural and urban middle-class voters. In 1913, there were strikes in the mines and on the waterfront, holding up the export of farm produce. At the gold-mining centre of Waihi, one miner was killed with a police baton. In Wellington, farmers rode into town and were enrolled as special constables to break the strikes of the watersiders. But attention was soon diverted from civil strife at home to the war heating up overseas.

World War I played a significant role in New Zealand's emerging nationhood. In one of the first actions of the war, New Zealand troops occupied German Samoa. New Zealand then made a massive contribution to the war in the Middle East and Europe. Some 120,000 New Zealand troops went to war—more per head than any of the Allied nations. These soldiers took heavy casualties: One in eight was killed. Initially, New Zealanders volunteered with reckless enthusiasm. But the flow slowed as the casualties mounted, and in 1916, the government introduced conscription.

On April 25, 1915, New Zealand and Australian troops, known as *Anzacs,* formed the main body of Allied troops who were landed on the Gallipoli peninsula. The action proved to be a heroic but ultimately fruitless attempt to take the Dardanelles from the Turks. The Allied troops were withdrawn at the end of the year, but Gallipoli—and especially the Anzac landing—have remained as one of the most important events in the history of New Zealand. See **Anzac.**

Later, New Zealand troops were sent to France, where they were involved in some of the heaviest fighting of the war. The New Zealand forces included a Maori battalion that made a significant contribution to the war, fighting at Gallipoli and in France.

During the war, Massey decided that a coalition government would help unite the country in its war effort. He formed a government from his own Reform Party and the Liberal Party, his chief opposition. The Labour Party remained in opposition.

Important dates

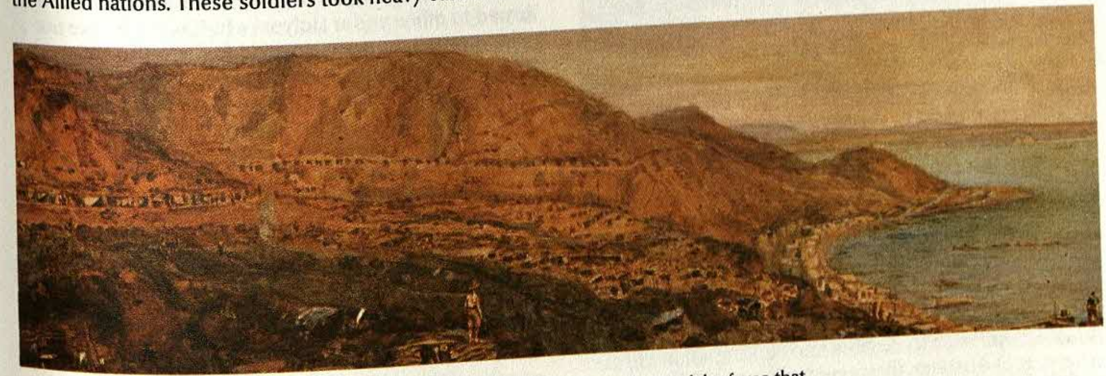
1914	New Zealand entered World War I.
1915	Anzacs landed at Gallipoli; Reform and Liberal parties formed a wartime coalition.
1919	Reform won the election.
1928	United defeated Reform.
1931	United/Reform coalition reduced wages, salaries, pensions.
1933	New Zealand pound was devalued by 25 per cent.
1935	Labour won the election.

Population

1936 Maori: 82,326; Europeans: 1,491,484.

After the war, the Reform and Liberal parties withdrew from their coalition government to fight the 1919 election. Reform won comfortably. When Massey died in 1925, Gordon Coates, an energetic and able ex-serviceman from North Auckland, again led Reform to victory.

Coates's government had to grapple with some deep-seated economic problems. A postwar boom had collapsed in 1921. Dairy and meat prices rose and fell, then collapsed altogether with the onset of the world depression in 1929. During this time, the government pushed



New Zealand soldiers, together with Australian troops, formed the main body of the force that landed at Anzac Cove at Gallipoli, Turkey, in 1915.

ahead with public works, particularly with the building of railways in the remote parts of the North Island.

Developments in technology include the motorcar and the milking machine. Electricity rapidly expanded through the construction of hydroelectric schemes. Radio began in New Zealand with broadcasts from IYA in Auckland in 1925.

In 1928, the Reform, United (previously Liberal), and Labour parties had another three-way contest. The United Party was led by Sir Joseph Ward, who promised to spirit away the depression by borrowing 140 million New Zealand dollars for an enlarged public works programme. United emerged from the election as the largest party, but needed Labour's support to govern.

The depression. The depression deepened after the crash of the New York Stock Exchange in 1929. Ward's government could not raise the 140 million New Zealand dollars loan and was forced to cut back on spending. In 1932, there were riots in the main cities. In 1933, unemployment reached 81,000—12 per cent of the work force. Some unemployed people were given jobs on important public works. But others were required to do jobs of little use because the government only granted unemployment benefits with work.

By contrast, the Labour Party appeared to have some remedies for the depression. Their finance spokesman, Walter Nash, promised to absorb unemployed workers by expanding public works. In the 1935 election, Labour gained a stunning victory, winning 53 seats.

The first Labour government (1935-1949)

Social welfare measures. The first Labour government was led by Michael Joseph Savage, who drew his socialism from Christian humanitarianism rather than Marxism. Bob Semple was put in charge of public works, and he embarked on an ambitious programme of road and hydroelectricity construction. Relief wages were raised, and a 40-hour week was introduced. A comprehensive state housing programme was started. The government guaranteed the prices of farm produce. The Reserve Bank was nationalized. Later, the largest of the trading banks, the Bank of New Zealand, and the largest internal airline, Union Airways Ltd., were nationalized, as were private radio broadcasting stations.

In 1938, after another substantial victory at the polls, Nash introduced a series of social welfare reforms. They included a comprehensive superannuation scheme for old-age pensioners and medical and child benefits.

World War II (1939-1945). When Britain declared war on Germany in 1939, New Zealand Prime Minister Savage said "where Britain goes, we go," and declared war.

Once again, New Zealand's war effort was concentrated on the Middle East and European arenas. New Zealand again introduced conscription to maximize the war effort. A New Zealand Expeditionary force was despatched to Egypt and then to Greece, where it suffered heavy casualties in an unsuccessful attempt to resist the German advance. The Allied troops were evacuated to Crete, where, under the command of the New Zealander Major General Bernard Freyberg, they almost repelled a massive German airborne attack. Many of the Allied troops were evacuated and regrouped in Egypt, where, at El Alamein, they eventually turned the tide against German Field Marshal Erwin Rommel's Afrika Corps. The New Zealanders, including a new Maori Battalion, formed a vital segment in Sir Bernard Montgomery's British Eighth Army, as that army swept across North Africa and fought its way up the Italian peninsula.

Some New Zealand pilots fought with distinction in the Battle of Britain. The New Zealand cruiser *Achilles* took part in the disabling of the German battle cruiser the *Graf Spee* on the River Plate. But, unlike Australia, New Zealand did not pull its troops back from the Middle East when Japan entered the war and moved menacingly southward—although in 1942, a Third Division of the Army was recruited to fight in the Pacific. Instead, New Zealand relied on the American navy and marines to ward off the Japanese. About 48,000 U.S. troops were stationed in the country by 1943.

Unemployment disappeared as men went to war and women to work on farms and in factories. Nash introduced a rationing of petrol, clothing, and some items of food. After the war ended in 1945, these controls became increasingly unpopular. The opposition National Party, led by Sidney George Holland, called the controls "socialist regulation." The Labour Party narrowly won the 1946 election. It held office only because of the four Maori seats, which was called the *Maori mandate.* But the National Party won in 1949.

Important dates

1936	Labour introduced guaranteed prices for farm produce and increased wages and benefits.
1938	Labour introduced comprehensive social security.
1939	New Zealand entered World War II against Germany.
1941	New Zealand entered the war against Japan.
1949	National Party won the election.

Population

1945	Maori: 100,044; Europeans: 1,747,697.

National dominance (1949-1972)

The early years of the Holland government were marked by industrial conflict. In 1951, Holland confronted striking wharf labourers by deregistering their union and recognising a new union formed by *scab* (strike-breaking) workers. New Zealand came close to violence. But, after 151 days, the strikers were defeated, and Holland won a snap election.

In 1957, a new National leader, Keith Holyoake, lost narrowly to the Labour Party. But the National Party returned to office under Holyoake in 1960. Holyoake presided over a prosperous period for more than 10 years. It was only when he was replaced by his deputy, Jack Marshall, just before the 1972 election, that National lost to the Labour Party led by Norman Kirk.

Important dates

1951	Waterfront strike led to a state of emergency and electoral victory for National leader Holland.
1957	Labour won the election.
1960	National was returned to office.
1965	New Zealand signed Limited Free Trade Agreement with Australia.
1967	Decimal currency was introduced.
1972	Labour was returned to office.

Population

1972	Maori: 235,938; Europeans: 2,720,320.

New Zealand since 1972

The 1960's were relatively untroubled years for New Zealand. By contrast, the 1970's and 1980's were years of economic uncertainty, unemployment, and social tension. In 1974, Maori demonstrated their discontent in a Land March to Wellington. In 1975, National Party leader Robert Muldoon made use of the Labour stand against South Africa's policy of *apartheid* (segregation of ethnic groups) to win the election campaign. In 1984, Muldoon was defeated by the Labour Party, led by David Lange. The new government instituted an antinuclear policy that brought it into conflict with the United States. The policy prohibited nuclear-armed or nuclear-powered warships from entering New Zealand ports, and in 1986, the United States announced that it would no longer guarantee New Zealand's security under the ANZUS defence treaty. Under the treaty, Australia and New Zealand continue to cooperate.

Important dates

1974	Oil prices increased, causing soaring inflation.
1975	National won the election.
1981	Springbok tour divided the country.
1982	New Zealand signed Closer Economic Relations Agreement with Australia.
1986	The United States declared that New Zealand was no longer a member of ANZUS.

Population

1991	Maori and Europeans: 3,434,949.

In 1984, the Labour government implemented radical changes to reform the New Zealand economy. Key sectors of the economy were deregulated, trade tariffs lowered, government enterprises privatized, and a goods and service tax was introduced. The New Zealand dollar was also floated, resulting in a considerable devaluation.

By 1990, the radical changes had resulted in little success. The new National government, headed by Jim Bolger introduced major reforms in government spending and the labour market. The welfare system was severely cut back. The Employment Contracts Act was introduced to deregulate the labour market. Although these policies were not popular, and the National Party's majority very small, improved economic activity during 1993 helped the National Party win another general election.

At the 1993 election, a national referendum was held. Voters agreed to replace the first-past-the-post system with a preferential voting system. See **Preferential voting.**

Related articles in ***World Book*** include:

Anzac
Cook, James
Du Fresne, Marion
Dumont D'Urville, Jules
Hone Heke Pokai
Hongi Hika
Maori
Marsden, Samuel
Moriori
New Zealand
Waitangi, Treaty of
Wakefield, Edward Gibbon

Outline

I. The founding of Aotearoa

II. European discovery and settlement (1642-1840)
- A. Tasman and the Dutch
- B. Cook's voyages
- C. French interest
- D. Commerce and Christianity

III. The colonial period (1840-1852)
- A. The Treaty of Waitangi
- B. Crown colony
- C. The New Zealand Company
- D. Heke's Revolt
- E. Colonization
- F. Constitution

IV. The provincial period (1852-1876)
- A. Provincialism and colonization
- B. The New Zealand Wars (1860-1872)
- C. Wool and gold

V. Continuous ministry and the long depression (1876-1890)

VI. The Liberal era (1890-1912)

VII. The Reform and United eras (1912-1935)
- A. World War I (1914-1918)
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VIII. The first Labour government (1935-1949)
- A. Social welfare measures
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IX. National dominance (1949-1972)

X. New Zealand since 1972

Questions

When did the Maori discover New Zealand?
What plants and animals did the Maori take to New Zealand?
What was the purpose of Tasman's voyage in 1642?
How did Cook prove that New Zealand was an island?
What industry helped to establish the first European settlements?
Why was the life of the missionaries very difficult at first?
What were the terms of the Treaty of Waitangi?
When were women granted the right to vote in New Zealand?
Where did the troops known as *Anzacs* fight in 1915?
What was the result of New Zealand's antinuclear policy?

Newark (pop. 275,221; met. area pop. 1,824,321), is the largest city in New Jersey, U.S.A. and one of the nation's leading centres of manufacturing and transportation. Newark lies on Newark Bay at the mouth of the Passaic River, about 16 kilometres west of New York City.

Blacks make up about 60 per cent of Newark's population. The city also has many people of Italian, Portuguese, and Puerto Rican descent. The production of drugs and chemicals is Newark's leading industry.

Newark lies on the west bank of the Passaic River, *rear,* where the river flows into Newark Bay.

Newark and Sherwood (pop. 103,400) is a local government district in Nottinghamshire, England. It includes the towns of Newark and Southwell and part of Sherwood Forest. Agricultural products from the district include wheat and barley. The chief industries are brewing, engineering, quarrying, and the production of clothes and roller bearings. Newark has the remains of a castle built in the 1100's. Southwell's minster is of the same date.

Newbery, John (1713-1767), was an English publisher and bookseller. He is famous in the history of children's literature as the first person to print and sell books for children. He published *A Little Pretty Pocket-Book* (1744) and *Goody-Two-Shoes* (1765) and many other little volumes bound in "flowery gilt," a colourful paper from the Netherlands.

Newbery's bookshop, The Bible and Sun, was in St. Paul's Churchyard, London. He was the friend and patron of Oliver Goldsmith, Samuel Johnson, and many other literary people of his day. Goldsmith portrayed him in his novel, *The Vicar of Wakefield* (1766). It is believed that Goldsmith wrote some of the quaint penny books published by Newbery. These little books are now highly prized. Thomas Babington Macaulay, a famous English essayist of the 1800's, called Newbery the "friend of children."

Newbery was born in Berkshire. The Newbery Medal was named after him (see **Newbery Medal**).

See also **Literature for children** (The 1700's); **Mother Goose.**

Newbery Medal is an annual award given to the author of the most distinguished contribution to American children's literature published in the preceding year. The award was established and endowed in 1921 by Frederic G. Melcher, chairman of the board of R. R. Bowker Co., publishers of the *Library Journal* and *Publishers' Weekly*. He named it after John Newbery, an English publisher and bookseller. Melcher also founded the Caldecott Medal. This award is presented annually to the illustrator of the outstanding children's picture book of the preceding year.

See also **Newbery, John; Caldecott Medal.**

Newbolt, Sir Henry (1862-1938), an English poet and author, is best known for his poem "Drake's Drum," included in his collection of ballads, *Admirals All* (1897). He published two other collections of ballads, *Songs of the Sea* (1904) and *Songs of the Fleet* (1910). Newbolt was born in Bilston, West Midlands.

Newbury (pop. 136,400) is a rural local government district in Berkshire, England. Farmers in the area grow cereals and market garden produce and raise sheep. The market town of Newbury, with its nearby racecourse, lies on the River Kennet. The Kennet and Avon Canal, much favoured for pleasure cruising, crosses the district. Newbury's industries include marine engineering and computer equipment manufacture. Bradfield independent school is in the district. Places of interest include Beedon, Eastbury, Greenham, Hungerford, Lambourn, and Pangbourne.

See also **Berkshire.**

Newcastle (pop. 293,368) lies on the estuary of the Hunter River, 160 kilometres north of Sydney, Australia. It is one of the largest cities in New South Wales. The City of Newcastle has an area of 215 square kilometres and its population includes 129,490 people living in 18 suburbs. The urban (metropolitan) area covers more than 958 square kilometres. More than 30 suburbs lie to the south and southwest of the city in the City of Lake Macquarie, which is the fastest growing part of the Newcastle area.

Rich coal fields were discovered in the Hunter Valley in 1797. The first export from the colony was a shipment of this coal, sent to Bengal in 1799. The availability of coal attracted heavy industry to the area, and led to the subsequent development of the Port of Newcastle.

The city has good education facilities at primary, secondary, and university levels. In 1989, the University of Newcastle, established in 1951, amalgamated with the Hunter Institute of Higher Education and Newcastle Conservatorium of Music. Newcastle also has a wide network of technical and further education colleges.

Newcastle has the largest regional art gallery in Australia. An annual spring festival called the Mattara has cultural and sporting activities, which last a week. A maritime museum is housed at historic Fort Scratchley. A regional museum and science centre was built to commemorate Australia's bicentenary in 1988.

Broken Hill Proprietary Co. Ltd. first established its steelworks at the Port of Newcastle in 1915. Newcastle is now the headquarters of its steel rod and bar products division. An aluminium smelter, opened in Tomago in 1984, now produces one-third of Australia's aluminium. Other heavy industry includes engineering and fabrica-

Broken Hill Proprietary operates steelworks in Newcastle. The company uses iron ore from South Australia and Western Australia.

tion, lead and zinc smelting, and shipbuilding and repair. Newcastle's economic base also includes food processing, electronics, chemicals, glass, ready mixed concrete, and textile and clothing products.

About 15 per cent of Newcastle's workforce are employed in secondary industry. Primary industry, which includes agriculture, mining, and fishing, also employs about 15 per cent of the workforce. But most of the workforce are employed in service occupations such as the professions, commerce and finance, transport, education, tourism, and building.

The port of Newcastle is the economic and trade centre for the Hunter region and much of northern New South Wales. Major exports include aluminium, coal, iron and steel, wheat, and woodchips.

Newcastle's climate is temperate. The average daily summer temperature ranges from 19° to 26° C, and from 9° to 16° C in winter. Average annual rainfall is about 105 centimetres.

The Pacific Highway links Newcastle and Sydney. Both the New England Highway and the Pacific Highway link Newcastle with Brisbane. An uninterrupted dual carriageway from Wahroonga to Hexham is due for completion in 1993, and will reduce travelling time between Sydney and Newcastle to two hours.

Newcastle is linked to Sydney by electrified rail line, while nonelectrified rail line extends north along the coast and to the northern tablelands. Train and bus services provide local suburban transport. Commercial flights operate from Williamtown and Pelican airports.

Newcastle is serviced by one commercial FM, and four commercial AM, radio stations, as well as three community service stations; one commercial television station, and television stations run by the Australian Broadcasting Corporation and Special Broadcasting Service, and a daily newspaper, *The Newcastle Herald.*

Government. Two local government councils administer the Newcastle area. The Newcastle City Council consists of a lord mayor and 12 aldermen. It provides municipal services, such as roadbuilding and recreation. Lake Macquarie City Council administers much of the outer metropolitan area.

History. In 1797, Lieutenant John Shortland sighted the Hunter River while searching for escaped convicts. He also discovered coal deposits, and as a result of his discovery, Governor Philip King surveyed the area. In 1801, colonists made an unsuccessful attempt to form a settlement. In 1804, a new penal village was established.

Newcastle remained a place of secondary punishment for convicts until 1823. Coal and timber were the main products of the settlement. In 1828, the Australian Agricultural Company acquired the sole rights to work coal deposits. This action attracted workers, and the area developed steadily. The monopoly was challenged in the 1840's, and with the subsequent growth of mining in the 1850's, Newcastle experienced rapid expansion.

Newcastle was incorporated as a municipality in 1859. Beginning in 1871, the small colliery townships that grew up around it were made municipalities. Ten of the municipalities were amalgamated with Newcastle in 1938 to form the Greater City of Newcastle.

The railway between Sydney and Newcastle was opened in 1889. In 1915, Australia's first large steelworks, operated by the Broken Hill Proprietary Co. Ltd., began production at Newcastle, and the city became a major industrial centre. Newcastle also became one of the largest ports in Australia. The State Dockyard was established within the port, at Carrington, in 1941. In the 1950's, the State Department of Public Works began reclaiming swampy land and developing industry and port facilities in Kooragang Island in the Hunter River opposite the steelworks. In the 1970's and early 1980's, the city's industry and trade continued to expand as massive coal reserves in the Hunter Valley were exploited.

On December 28, 1989, an earthquake struck Newcastle and claimed 12 lives.

Newcastle, Duke of (1693-1768), was prime minister of Britain during most of the Seven Years' War (1756-1763). During the war, the British Empire was greatly extended in North America and in India.

Thomas Pelham was the son of an East Sussex landowner. In 1711, when he succeeded to the estate of his uncle John Holles, he changed his name to Pelham-Holles. In 1712, he succeeded his father as Baron Pelham. In 1714, he supported the Act of Settlement, which established the Hanoverians on the British throne. Shortly afterwards, Pelham-Holles was created Duke of Newcastle. He was secretary of state for 30 years. He succeeded his brother, Henry Pelham, as prime minister in 1754. In 1756 and 1757, Newcastle was replaced as prime minister by the Duke of Devonshire. But he then returned to office and was prime minister until 1762.

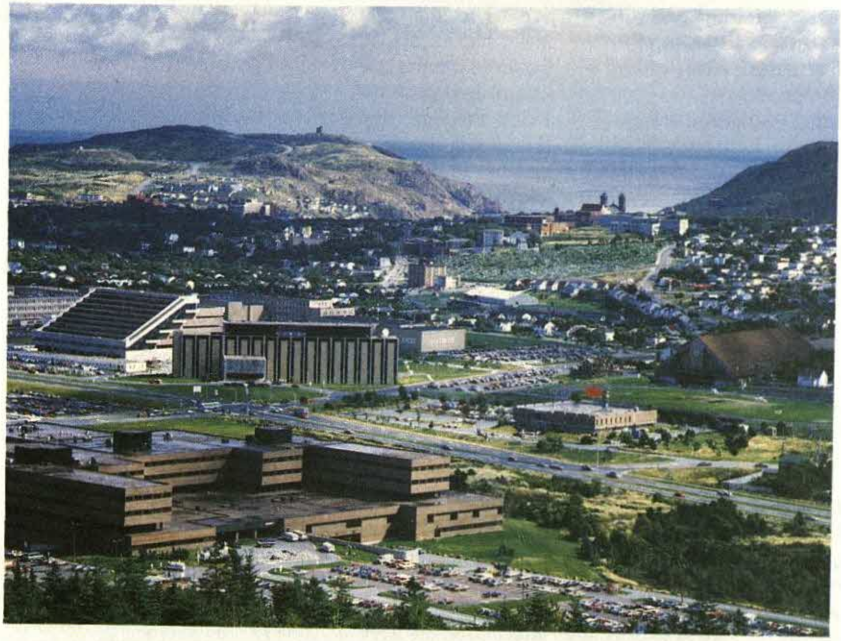
Newcastle-under-Lyme (pop. 117,400) is a local government district in Staffordshire, England administered from the town of Newcastle-under-Lyme. The district is situated on the North Staffordshire coalfield and to the west of the area of the Potteries. Many people who live in the district are employed in the coal-mining and pottery industries. The district also includes Keele University. Newcastle-under-Lyme is so named because the town was *under* (near) the former Lyme Forest.

Newcastle upon Tyne (pop. 263,000) is a local government district and city in the county of Tyne and Wear, England. It is located at the main road and rail crossings of the River Tyne. It developed as a commercial, heavy engineering, and shipbuilding centre.

The city centre lies between the River Tyne and the Town Moor, a bare open space. Much of the centre was laid out in the mid-1800's, with dignified roads and buildings. Grey Street, the finest street in the city, contains the porticoed Theatre Royal. Other important buildings include St. Nicholas's Cathedral, built mostly in the 1300's; All Saints' Church, designed in the mid-1700's; and the Old Assembly Rooms, completed in 1776. The University of Newcastle received its charter in 1963. It was formerly part of Durham University.

The Romans built a bridge at Newcastle, at a point where a swing bridge now stands. They called the place *Pons Aelius* after the bridge. It was a station on Hadrian's Wall. The Roman camp stood on the ground now occupied by remains of the castle—a keep dating from the 1170's, and the Black Gate, the castle gatehouse. Both the keep and the gatehouse are now museums. Parts of the city walls, dating from the reign of Edward III, remain. The city was besieged in 1644, during the Civil War. Charles I was held a prisoner there in 1646.

In 1980, an underground railway system opened in Newcastle. It is called the *Metro.*



Memorial University, located in St. John's, is Newfoundland's only university. The school was founded in 1925 as Memorial University College and began granting degrees in 1950.

Newcombe, John (1944-), an Australian tennis player, won the Wimbledon singles title in 1967, 1970, and 1971. He won the United States singles title in 1967 and 1973. He was a member of successful Australian Davis Cup teams in 1965, 1966, 1967, and 1973. Newcombe also won the Wimbledon doubles in 1965, 1966, 1968, 1969, 1970, and 1974. He won the Australian singles in 1973 and 1975. He was born in Sydney.

Newcomen, Thomas (1663-1729), an English inventor, built the first commercially successful steam engine in 1712. His steam engine was used widely in Europe and throughout Great Britain's coal-mining regions to remove water from mines. It remained popular for over 60 years until the Scottish engineer James Watt developed a greatly improved steam engine.

Newcomen was born in Dartmouth. While selling metal tools, he learned of the difficulty of pumping water from tin mines. After several years of experiments, Newcomen developed an engine that used air pressure as its driving force. Water was injected into a large metal cylinder filled with steam, condensing the steam and creating a vacuum. The weight of the atmosphere then pushed a piston to the bottom of the cylinder, pulling up the pumps connected to the piston and raising water. The engine worked automatically. To sell his engines, Newcomen formed a partnership with inventor Thomas Savery, who had a patent on a different device that raised water from mines.

Later Newcomen engines were huge, with cylinders 2 metres in diameter and more than 3 metres long. They could pump over 13 million litres of water a day.

See also **Steam engine** (History; picture: Thomas Newcomen's steam engine); **Hooke, Robert.**

Newfoundland (pop. 568,349) is Canada's newest province. It includes the island of Newfoundland and the coast of Labrador, a part of the Canadian mainland. Newfoundland became a province of Canada in 1949. St. John's is the capital and largest city of Newfoundland. This bustling city ranks among the oldest communities in North America. Cod, salmon, and other fishes thrive along Newfoundland's shores.

St. John's, on the Avalon Peninsula, is Newfoundland's capital and largest city. Corner Brook is Newfoundland's only other city.

Newfoundland dog is one of the largest and strongest breeds of dog. Male Newfoundlands weigh about 65 kilograms. Females are slightly smaller. Newfoundlands have a thick double coat that protects against all types of weather. The most common colour is black, often with a patch of white on the chest, chin, or toes. These dogs also may be grey, brown, or white with black markings.

No one knows exactly when the Newfoundland was developed. The breed was used for heavy work, both on land and in water. Early steamships and sailing vessels frequently included a Newfoundland as a crew member. These dogs are still known for their work in the water and their tendency to help swimmers in distress. They have large, webbed feet and are good swimmers.

Newfoundlands are eventempered, intelligent, and confident. Their patience, playfulness, and protectiveness make them excellent companions for children.

See also **Dog** (picture: Working dogs).

Newgate Prison, a London jail, was England's main criminal prison for over 700 years. It was torn down in 1902, after years of protest about its shameful condition. The prison originally was part of London's West Gate, an entranceway to the city. West Gate was rebuilt and renamed Newgate in the 1100's. Prisoners were held in a room above the entranceway. Newgate was rebuilt again about 1423. But the Great Fire of London damaged it in 1666, and its condition grew steadily worse. Many prisoners died because of overcrowded rooms, poor food, and such contagious diseases as *jail fever* (typhus). Women, children, and debtors lived with hardened criminals in Newgate Prison. Few reforms were adopted until the 1800's. After 1815, debtors were held elsewhere. After 1847, only people awaiting trial were kept at Newgate.

Newham (pop. 200,200) is a borough in Greater London. The borough includes the former boroughs of East Ham and West Ham, the western part of Barking, and the part of Woolwich north of the River Thames. The borough includes part of London's docklands, which underwent extensive redevelopment during the 1980's and early 1990's.

Newman, John Henry Cardinal (1801-1890), became a convert to the Roman Catholic Church in 1845, and was made a cardinal in 1879. Before his conversion, he had distinguished himself as a scholar and a preacher of the Church of England at Oxford University. In 1833, he joined the movement within that church to rid it of political domination and to ground it more firmly in traditional beliefs (see **Oxford Movement**). The movement helped strengthen the established church, but Newman shocked his fellow reformers when he joined the Roman Catholic Church. In 1846, he became a Catholic priest.

Newman was born in London. For most of his life as a Catholic, he lived in Birmingham as rector of an *oratory,* a group of men devoted to prayer and studies. He was considered one of the great thinkers of the 1800's.

Cardinal Newman's autobiography, the *Apologia pro Vita Sua* (1864), was an answer to an attack upon him by Charles Kingsley, an Anglican minister and author. Among Cardinal Newman's many lectures is "The Idea of a University" (1852). *The Grammar of Assent* (1870) was his answer to religious scepticism. Newman also wrote the words of the hymn "Lead, Kindly Light."

Newman, Paul (1925-), an American actor, won fame for his action roles and convincing character studies in films. He portrayed outsiders or rebels in many of his films. Newman won the 1986 Academy Award as best actor for his performance in *The Color of Money.*

Newman was born in Cleveland and studied acting at Kenyon College, Yale University, and the Actors Studio. He made his Broadway debut in *Picnic* (1953) after appearing in several television dramas. Newman's first film was *The Silver Chalice* (1955). He gained stardom in *Somebody Up There Likes Me* (1957). Newman's other films include *The Hustler* (1961), *Hud* (1963), *Harper* (1966), *Hombre* (1967), *Cool Hand Luke* (1967), *Butch Cassidy and the Sundance Kid* (1969), *The Sting* (1973), *Slap Shot* (1977), *Absence of Malice* (1981), and *The Verdict* (1982). Newman also starred on Broadway in *Sweet Bird of Youth* (1959).

Paul Newman

Newman directed *Rachel, Rachel* (1968) and *The Effect of Gamma Rays on Man-in-the-Moon Marigolds* (1972). Both these films starred his wife, the Academy Award winning actress Joanne Woodward.

Newmarket is a town in Suffolk, England, famous as the centre of British horse racing and breeding and as the headquarters of the Jockey Club. See **Suffolk.**

Newport (pop. 129,900) is a local government district in Gwent, Wales, centred on the town of Newport. The town has extensive port facilities. Its industries include metalworking, engineering, and the manufacture of chemicals and electrical equipment. Newport town has a Norman cathedral and the remains of a Norman castle. Nearby is the site of a Roman settlement at Caerleon.

Newport is also the name of many other places in the United Kingdom. There is a Newport in Shropshire and another on the Isle of Wight. See **Wales.**

Newry and Mourne (pop. 82,237) is a local government district in Northern Ireland, situated in the southeast of the province. The town of Newry is in view of the Mourne Mountains. Newry's industries include textile production, meat processing and packing, and bacon curing. Quarries produce granite in the district. The most important crop is potatoes. Newry also has port facilities. Greencastle is the site of a castle built in 1261. Rostrevor, a sheltered spot, grows Mediterranean plants. See **Northern Ireland.**

News media. See **Journalism.**

News service is an organization that collects and distributes news. Many newspapers and television and radio stations rely on news services for national and international news. Few papers and stations can afford their own national and foreign correspondents. News services developed from organizations set up in Europe during the 1820's and 1830's to provide economic news to private clients. News services were once known as *wire services* because they sent their reports by wire to printing devices called teletypewriters.

News services have reporters stationed in major cities throughout the world. These companies, also called *news agencies* or *press agencies,* transmit the news gathered by their reporters and others to newspapers and other news organizations that pay for this service. The news text and photographs are sent by satellite, or wire. Television and radio stations also subscribe to news services for news summaries written to be broadcast by local announcers.

All subscribers to a news service receive the same stories, with a few differences for regional events and such specialized news as financial and sports items.

The major news services include the Associated Press (AP) and United Press International (UPI) of the United States, Reuters of the United Kingdom, Tass of Russia, Agence France-Presse of France, and Xinhua of China.

Some large newspaper groups with their own staff of national and foreign correspondents operate a form of news service sometimes called a *news syndicate.* These papers sell subscribers stories that appear in the publications themselves. Other news services, called *feature syndicates,* provide various materials, including columns of health advice, humour, and political opinion; editorial cartoons; and crossword puzzles.

Television news services furnish visual world coverage for televised news. These companies send newscasts and filmed or taped segments of news events to member television stations.

See also **Associated Press; Reuters; Tass; United Press International.**

The news room of a big-city newspaper hums with activity as the editorial staff hurries to prepare stories on the day's events. These writers and editors are using special computer terminals to enter their stories into the newspaper's electronic editing system.

Newspaper

Newspaper is a publication devoted chiefly to presenting and commenting on the news. Newspapers provide an excellent means of keeping well informed on current events. They also play a vital role in shaping public opinion.

Newspapers have certain advantages over the other major news media—television, radio, and news magazines. For example, newspapers can cover more news—and in much greater detail—than can television and radio news bulletins. News magazines concentrate on the chief national and international events of the preceding week. But daily newspapers report local as well as national and international news on a day-to-day basis.

A large daily newspaper provides a great variety of information. News stories cover the latest developments in such fields as government, politics, sports, science, business, and the arts. Other news stories report crimes, disasters, and special events of human interest. Editorials and columns of opinion comment on controversial issues. Informative feature articles examine a wide range of subjects, including fashion, health, and child care. Comic strips, advice columns, and other entertainment items also appear regularly in most daily papers.

Producing a daily newspaper requires great speed and efficiency. Reporters, editors, and photographers work under the constant pressure of deadlines. A large daily also employs many other workers, including advertising salespeople, artists, librarians, printing-press operators, and truckdrivers. The entire staff must operate as a well-drilled team if the papers are to reach homes and newsstands on schedule.

This article describes the kinds, organization, production, and business operations of newspapers. It then traces the history of newspapers.

Kinds of newspapers

Newspapers are printed on coarse paper called *newsprint.* There are two major sizes of newspapers—*standard* and *tabloid.* A standard-sized newspaper has pages that measure about 38 by 58 centimetres. The pages of a tabloid are about half that size.

The standard and tabloid sizes are both used in publishing all types of newspapers. The three main kinds of papers are (1) daily newspapers, (2) weekly newspapers, and (3) special-interest newspapers.

Daily newspapers print world, national, and local news. They also carry editorials, opinion columns, feature articles, and entertainment items. Big-city dailies print many stories on social and political issues, such as the quality of schools and the efficiency of government.

Many dailies are morning papers, others are afternoon papers, and a few publish around the clock. In large cities, many morning papers publish several editions—the first one in early evening and the last one in the early morning. Similarly, many afternoon papers publish from early morning to late afternoon.

In some countries, additional features and more ad-

The staff of a small weekly newspaper may consist of only the editor and a few assistants. Together, they do all the work, from gathering and writing the news to printing the paper.

vertising make Sunday newspapers much larger than weekday editions. Numerous Sunday papers have special sections on such topics as entertainment, finance, and travel. They may also include a Sunday magazine, a guide to television programmes, and coloured comics.

Weekly newspapers, in general, serve much smaller areas than daily papers and publish news of a more personal nature. In small communities, most people know one another and take great interest in the activities of their friends and neighbours. Weddings, births, and deaths are major news items. A fire or traffic accident gets front-page coverage. Weeklies also report news of local business and politics. Most weekly newspapers do not carry national or world news.

Special-interest newspapers print news of concern to particular groups. Many large companies and trades unions publish newspapers for their members. Newspapers printed in foreign languages serve foreign-born residents in big cities.

The staff of a newspaper

The number of people needed to produce a newspaper varies greatly. The smallest weekly papers may have only 1 to 3 workers, who do everything from writing the news, to selling advertising space, to running the press. Larger weeklies employ 10 to 30 people. The largest metropolitan dailies have more than 1,000 employees.

The staff of a large metropolitan daily is headed by the publisher, who in some cases owns the paper. The staff of such a paper is divided into three main departments: (1) the editorial department, (2) the business department, and (3) the mechanical department.

The editorial department is responsible for the news and features that the paper prints. The head of the department is called the editor in chief, executive editor, or simply editor. The editor in chief must have a thorough knowledge of all phases of newspaper work and know how to deal with people well.

A managing editor helps the editor in chief direct the members of the editorial staff. Under the managing editor are assistant managing editors and news editors. Other editors are responsible for news in certain areas. For example, most large dailies have a city editor, a suburban editor, and a foreign editor. The various sections and departments of the paper, such as the sports, arts, and financial sections, also have an editor of their own. Each editor supervises a staff of reporters, writers, and other workers. Some editors, such as the sports and financial editors, may write a daily column in addition to their supervisory duties.

The editor in chief directs a staff of editorial writers, as well as the news staff. In many cases, the publisher helps to guide these writers. Thus, a newspaper's editorials often express the views of the publisher. Metropolitan dailies also employ special columnists to write columns of humour, advice, or general information.

Large newspapers provide special facilities to assist the editorial staff. For example, a library keeps copies of past stories and pictures as well as such resources as almanacs and encyclopedias. In addition, artists and photographers need special facilities to do their work. A newspaper must also have a photo lab where pictures can be processed speedily.

The business department tries to ensure that the paper makes a profit. A business manager heads the department with the help of an advertising manager, a circulation manager, and a promotion manager. The advertising manager directs a staff that sells advertising space to shops, manufacturers, and other businesses as well as classified ads to individuals and firms. The circulation manager supervises the distribution of the newspaper by carriers, newsstands, and mail. The promotion manager develops ways of drawing attention to the paper to attract new readers and new advertisers. The business department also has accountants and bookkeepers to handle the financial records.

The mechanical department prints the newspaper. A production manager directs the department's operations. Some workers set the type, and others arrange the stories, photographs, and advertising to make up the pages. Still other workers produce the printing plates from which the newspaper is printed. The printing-press operators lock the plates on the presses and print the papers. Mailroom personnel assemble the papers and turn them over to the circulation department.

How newspapers are produced

Gathering the news is the first step in the production of a newspaper. A paper gets the news it prints from two main sources: (1) its own reporters and (2) news services.

Reporters use interviews, research, and investigative techniques to gather information for their stories. They must have well-developed "news judgment" to sort out important stories from those that have little public interest.

A newspaper employs several kinds of reporters. Many reporters cover a speciality. Some speciality reporters are assigned to particular buildings, including police stations and the criminal courts. Other reporters cover a particular subject, such as science, education, or consumer affairs. Certain other reporters cover any story to which they are assigned or which they find on their own. A general assignment reporter may assist a speciality reporter if too many stories break on a topic for one person to handle.

The news staff of a big-city newspaper also includes *investigative reporters* and *stringers.* Investigative reporters search out and expose political corruption or other wrongdoing. They may work weeks or months to get a story or a series of stories. Stringers do not work full time for the newspaper but occasionally turn in a story. Stringers for big-city newspapers may have a permanent job with a regional newspaper or a small radio station.

The largest papers have foreign correspondents in the major cities of the world, such as London, Paris, Moscow, Washington, and Tokyo. But not even the largest newspapers can afford to have reporters in all the major cities. As a result, newspapers depend on news services or *wire services* for at least part of their national and foreign news. Each news service has hundreds of reporters in various countries. The news services transmit news reports and photographs to newspaper offices over a *teleprinter* and *telephoto* system, or via satellite (see **Telephoto; Teleprinter**). Major news services include Agence France-Presse in France, Reuters in the United Kingdom, Tass in Russia, and Associated Press (AP) and United Press International (UPI) in the United States.

Many papers also get news from *news syndicates.* A news syndicate is owned by a newspaper or chain of newspapers with a large staff of reporters around the world. A syndicate distributes to its clients many stories that it prints in its own paper or papers.

Writing and editing stories. Some reporters write their own stories, but many stories are written by subeditors. Subeditors do not rewrite material but get the facts, usually by telephone, from a reporter and assemble them into a story. Subeditors may also make many phone calls themselves to gather additional information for stories. In writing a news story, reporters or subeditors begin by giving the important facts in the first paragraph, which is called the *lead.* They then present the details in the rest of the space given to the story by the news editor.

The completed story goes to a copy editor, who checks it for accuracy and writes a headline for the story. The copy editor may also change the wording in places to make the story more readable, and must cut material from the story if it is too long.

Many newspapers use computerized editing systems. With these systems, writers and editors use *video display terminals* (VDT's) instead of typewriters and pencils. A VDT consists of a typewriterlike keyboard with an electronic screen attached. As a reporter or subeditor types out a story on the keyboard, it appears on the screen. Special keys enable the writer to make corrections, insert information, and rearrange sentences or paragraphs. The completed story is stored in the computer's memory banks. At a touch of a button, a copy editor can call up the story and edit it on a VDT like the one used by the writer. VDT's are sometimes also called *cathode-ray tube terminals* (CRT's).

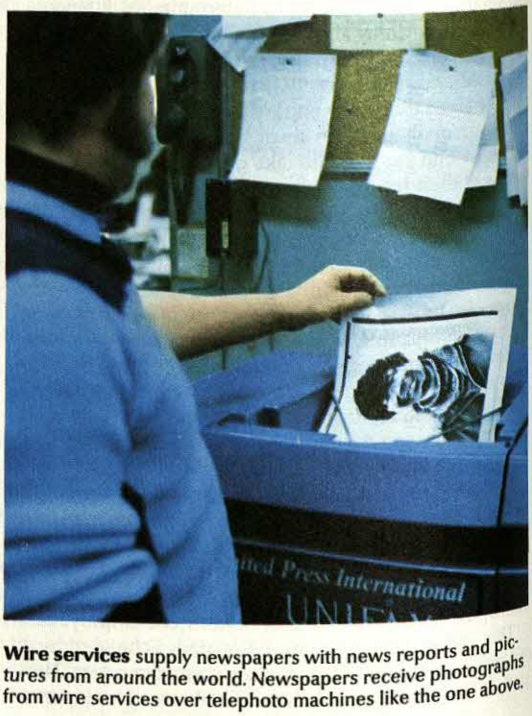
Preparing editorials and features. Each day, a newspaper's editorial writers meet and select the topics for forthcoming editorials or *leaders.* They also decide what viewpoint to take in the editorials. Unlike a news story, an editorial expresses an opinion and tries to sway readers to that way of thinking.

Feature writers prepare stories on any subject they think would interest the newspaper's readers. Common types of feature articles include interviews with famous entertainers, stories on unusual organizations, and descriptions of places to visit. Newspapers also get feature material from *feature syndicates,* which resemble news syndicates. Feature syndicates provide such items as cartoons, comic strips, crosswords, and columns on gardening, financial matters, and other subjects.

Setting the type for all the stories, editorials, and feature articles is a big job. Some newspapers use metal type—small pieces of metal with raised letters on top. However, an increasing number of newspapers are using photographic type, which consists of photographic images of letters.

Newspapers that use metal type set the type on a Linotype or a similar machine. The Linotype produces full lines of type, called *slugs,* by pouring molten metal into moulds of each letter. After each slug hardens, it drops into a tray called a *galley.* See **Linotype.**

Photographic type is produced by a method called *photocomposition.* Newspapers use several kinds of photocomposition machines, which produce "galleys" of



Wire services supply newspapers with news reports and pictures from around the world. Newspapers receive photographs from wire services over telephoto machines like the one above.

Newspaper terms

Banner is the top headline on page 1.

Beat is a news field to which a reporter is regularly assigned, such as consumer affairs or criminal courts.

By-line is the name of the writer of a news story, feature article, or special column. In most cases, it appears just beneath the headline.

Copy means the manuscript of any news matter prepared for typesetting.

Dateline refers to the line at the beginning of a news story that tells where and, in some cases, when the story originated.

Deadline is the time limit for a certain stage in preparing material for a particular edition.

Edition means any issue of the newspaper. Large newspapers issue several editions during the day or night.

Extra is an edition of a newspaper published at a time other than a scheduled regular edition.

Lead is the opening paragraph of a news story. In most cases, it summarizes the important information in the story.

Masthead includes the title of the newspaper and the names of the publisher and principal editors. In most cases, it appears on the editorial page.

Scoop refers to a story obtained by a newspaper without the knowledge of its competitors. A scoop is also called an *exclusive.*

Squib means a brief story that is unimportant from a news standpoint and is used chiefly to fill space.

Subhead is a short heading used to break up the paragraphs of a long news story.

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type on photographic paper.The most modern photocomposition machines are linked to computers that determine the spacing between words and how to hyphenate words that are continued on the next line. See **Photocomposition.**

Making up the pages. After the type has been proofread, it goes to a worker who *makes up,* or lays out, the pages. The worker follows the news editor's rough layout of where the stories and pictures should appear. To make up a page of metal type, a worker inserts the galleys of type and engravings of the illustrations into a metal frame to produce a *type forme.* To make up a page of photographic type, the stories, ads, and illustrations are pasted up on a plastic sheet. The made-up pages are then used to make printing plates.

Printing the paper. Newspapers use one of two main printing methods—*letterpress* or *offset lithography.* In letterpress, the printing plates have a printing surface raised above the background area. In offset lithography, which is often called simply *offset,* the printing surface is on the same flat level as the nonprinting parts. With either method, newspapers are printed on *rotary presses,* which have cylinders to hold curved printing plates. But before the printing can begin, workers must produce the printing plates.

To make a printing plate from a page of metal type, workers first make a mould of the type forme, using a sheet of cardboardlike paper. They then pour molten metal into this mould to make a curved printing plate called a *stereotype.* Newspapers use stereotypes for letterpress printing.

The first step in producing a printing plate from photographic type is to photograph the pasted-up page. This process produces a negative of the entire page. The negative is then placed on a thin metal or plastic plate with a light-sensitive coating and exposed to bright light. The light passes through the transparent (image) parts of the negative and hardens the coating under these parts. The other parts of the negative block the light, and the coating under them remains soft. Workers rinse the plate to wash away the soft, unexposed parts. Only the hard image remains.

Newspapers can use photographically produced plates with either letterpress or offset printing. For letterpress, the plates must be placed in an acid bath to etch away a bit of the background and leave the image area slightly raised. Stereotypes are then made from the etched plates. For offset, the exposed plates are chemically treated in such a way that the coated image areas will accept ink and the blank background areas will repel ink. Printers mount these offset plates directly on the printing press. Offset printing enables a newspaper to skip the etching and stereotyping steps. It is thus faster than letterpress and requires fewer workers.

After all the printing plates have been made and mounted on the press, the press goes into action. A roll of paper is drawn through the press, receiving the print of all the plates. At the farther end of the machine, the paper is cut into sheets and folded into pages. For more information on printing, see **Printing** and **Photoengraving and photolithography.**

Business operations

Newspapers earn about two-thirds of their income from the sale of advertising space. Most newspapers get the rest of their income from sales of the paper. The syndication of news stories or features provides additional revenue for some large papers. A newspaper's advertising department handles the sale of *ads* (advertisements), and the circulation department manages the distribution and sales of the paper.

Advertising, on average, fills about 60 per cent of the space in most newspapers of the world. Papers sell much of this space to local businesses and individuals. National firms buy the rest.

Newspapers carry two forms of advertising—*display ads* and *classified ads.* Most display ads include illustrations and may be as large as two full pages. Newspapers have a staff of artists and layout personnel to help prepare these ads. Classified ads appear in a separate section of the paper. Most consist of a few lines of print and advertise such things as used cars, job openings, and property for sale or rent.

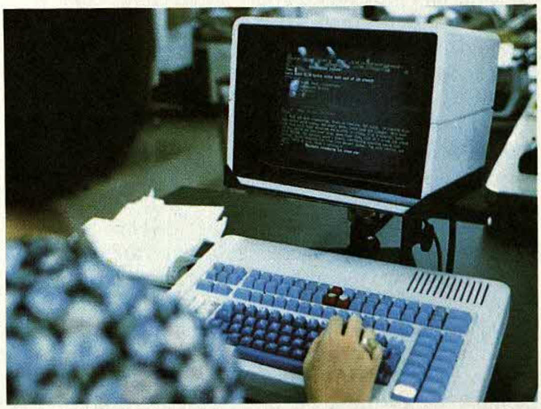
The advertising manager directs division supervisors, who have charge of various kinds of advertising, such as advertising for car dealers, department stores, and supermarkets. Each division supervisor has a staff of sales representatives who sell ads to businesses. Workers in the classified-ad department sell ads over the telephone. They also help people to write their classified ads. In addition to a local advertising staff, many newspapers have sales representatives in other cities.

Circulation. The distribution of newspapers is a complex operation. After the papers come off the press, conveyor belts carry them to the mailroom. Most of the papers are wired into bundles. The rest are addressed for mailing. The bundles of papers travel down chutes to the loading dock, where trucks are waiting to carry them to newsstands and distribution centres.

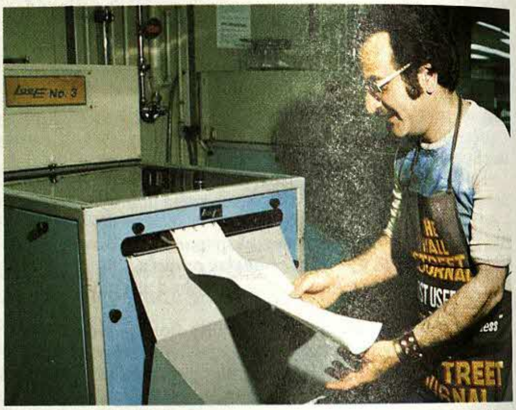
The circulation manager oversees the distribution of papers and works with the promotion manager to try to

How a newspaper is produced

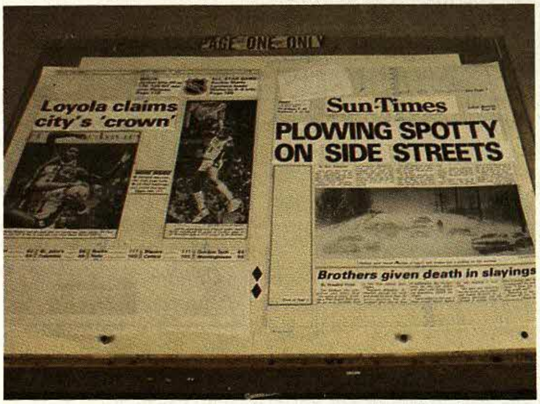
The methods used in producing newspapers vary. Since the 1960's, many papers have modernized their production facilities. The pictures on this page show the methods used by one daily paper.



Editing the stories is the task of copy editors. In the photograph above, a copy editor uses a video display terminal (VDT) to make changes in a story and prepare it for typesetting.



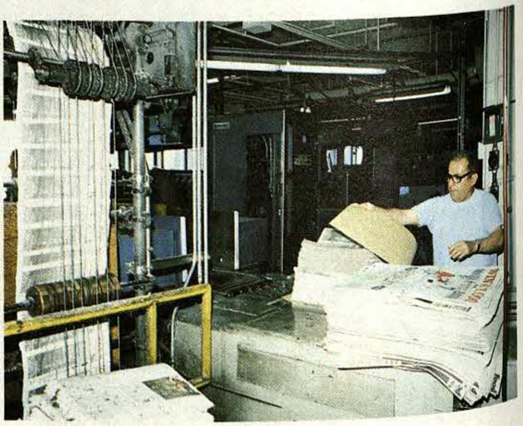
Setting the type is done by photocomposition machines, which produce galleys of type on photographic paper. Computers automatically determine the spacing between words.


PAGE ONE ONLY
Loyola claims city's 'crown'
Sun-Times
PLOWING SPOTTY ON SIDE STREETS
Brothers given death in slayings

Making up the pages involves pasting up the stories on a plastic sheet. This "paste up" is then photographed to produce a negative, which is used to make an engraved plate.

Making the printing plates. The negatives are placed on a metal or plastic plate with a light-sensitive coating. They are exposed to a bright light, which forms a hard image on the plate.

Printing the paper. After all the printing plates are in place, a roll of paper is drawn through the press. A device on the press cuts the printed paper into sheets and folds them into pages.



Freshly printed newspapers are carried by conveyor belts to the mailroom. There they are bundled and then sent to the loading dock, where delivery trucks are waiting.

increase the number of readers. Supervisors of city sales, suburban sales, and home delivery work under the circulation manager. District circulation supervisors look after sales in various areas of the city or suburbs. Newspaper delivery boys and girls also make up an important part of the distribution system.

Newspapers around the world

American newspapers are generally the bulkiest in the world. Many papers in other countries have no more than 8 or 10 pages, devoted mainly to political and governmental affairs, with only a few ads and features.

Sweden leads the world in newspaper readership with about 572 copies sold daily for every 1,000 people. Other countries with high newspaper readership include Japan, Germany, and Finland. In general, circulations are large in industrialized nations. Poverty and illiteracy restrict readership in developing countries.

In most nations, the government controls to some extent what newspapers may publish. Freedom of the press exists mainly in English-speaking nations, in most countries of Western Europe, and in Israel and Japan. See **Freedom of the press.**

In Africa and the Middle East, the governments of most nations maintain tight control over what appears in the press. Israel has the only truly free press in that part of the world, and even the Israeli government strictly controls military news. South Africa claims to have a free press, but in reality many laws restrict freedom of the press there. In addition, some South African newspapers practice self-censorship to avoid government interference in their operations. Most Arab countries have laws that allow government officials to censor news before publication. In Egypt, the government owns all the newspapers, including *Al Ahram* of Cairo, which is the most influential paper in the Arab world.

In Asia, Japan and China have the most highly developed press systems. Japan's leading newpapers—*Asahi Shimbun, Mainichi Shimbun,* and *Yomiuri Shimbun*—circulate nationally. Each publishes a Tokyo edition and several regional editions. *Asahi Shimbun* has the largest circulation of any paper in the world—more than 11 million copies per day. China's largest newspaper is *Renmin Ribao* (People's Daily) of Beijing, the official paper of the Chinese Communist Party.

In India, about 2,000 daily newspapers are published in more than 80 languages. They have a total circulation of about 17 million. The English-language press remains influential. Daily papers such as the *Times of India,* the *Indian Express,* the *Hindu,* and the *Statesman* circulate widely among the urban middle classes.

Australasia. Australia has 22 daily newspapers, with a combined circulation of more than 3.5 million. The most important papers are published in the various state capitals, particularly in Sydney and Melbourne. The best known are the *Sydney Morning Herald,* the *Herald* (Melbourne), and the *Sun News Pictorial* (Melbourne). In 1964, a national paper called *The Australian* was started. It is published simultaneously in Melbourne, Sydney, Perth, Brisbane, and Townsville.

New Zealand has 34 daily newspapers, with a total circulation of about 1 million. The best known are the *New Zealand Herald* (Auckland), *The Dominion* (Wellington), the *Auckland Star,* and the *Star* (Christchurch).

Europe. The people of the British Isles are among the world's keenest newspaper readers. Britain and the Republic of Ireland have fewer daily papers than many countries but these papers have bigger *circulations* (numbers of copies sold) than those of almost any other country. Britain and Ireland, with a total population of about 60 million, have about 120 daily papers. Sunday newspapers have a circulation of several million. Regional daily papers have circulations ranging from about 10,000 to nearly 300,000.

Britain has 10 national daily papers. They are the *Daily Express,* the *Daily Mail,* the *Daily Mirror,* the *Daily Telegraph, The Guardian, The Independent, The Sun, The Times,* the *Financial Times,* and *Today.* Ireland has three national papers—the *Irish Independent, The Irish Press,* and *The Irish Times.*

Before World War II (1939-1945), most newspapers in France were associated with some political party or special-interest group. Each of these papers wrote its news from a particular political viewpoint. Today, the Communist paper *L'Humanité* is the only party paper with a wide circulation in France. Other French papers have political leanings, but they report news from a basically neutral point of view. Some French newspapers, such as the Paris papers *Le Figaro* and *Le Monde,* provide excellent coverage of the arts. Other French newspapers that are widely circulated include *L'Aurore, France-Soir,* and *Le Parisien Libéré.* All these newspapers are published in Paris.

In 1990, before German reunification, Western Germany had a total of 356 daily newspapers. The combined circulation of all daily papers in the country was more than 20 million. Outstanding German newspapers include the *Frankfurter Allgemeine* of Frankfurt (am Main), *Süddeutsche Zeitung* of Munich, *Die Welt* of Bonn, and *Neues Deutschland* of Berlin. The leading Italian newspapers include *La Stampa* of Turin and *Corriere della Sera* of Milan. Three daily papers are published in Rome, the most important being *La Republica.*

In Latin America, government control of the press is common. Some Latin-American nations officially restrict what newspapers may print. Certain others practise indirect forms of censorship. For example, the government may own the nation's paper supplies. In that case, a newspaper that criticizes government leaders may find it difficult to buy newsprint. Major Latin-American newspapers include *La Prensa* and *La Nación* of Buenos Aires, Argentina; *O Estado de São Paulo* of São Paulo, Brazil; and *Excélsior* of Mexico City, Mexico.

North America. In Canada, newspapers are similar to U.S. papers in size and content. Canada has about 120 daily newspapers and more than 1,100 weeklies. Two newspaper chains—Southam Inc. and Thomson Newspapers—own about half the nation's dailies and control about half the daily circulation. The leading English-language dailies include *The Gazette* of Montreal and two Toronto papers—the *Star* and the *Globe and Mail. La Presse* of Montreal is Canada's largest French-language daily.

In the United States, most daily newspapers chiefly serve a metropolitan area or local region. Many political and governmental decisions are made locally. Largely for that reason, there are few national newspapers.

The United States has about 1,700 daily and 7,500 weekly and twice weekly newspapers. Their circulations range from a few hundred copies per issue for some weekly papers to more than a million copies for the largest daily papers. The total circulation of daily papers in the United States exceeds 60 million copies.

Notable U.S. daily papers include the *Boston Globe, Chicago Tribune, Los Angeles Times, New York Daily News, New York Times, Philadelphia Inquirer,* and *Washington Post.*

History

Handwritten newssheets posted in public places probably were the first newspapers. The earliest known daily newssheet was *Acta Diurna* (*Daily Events*), which started in Rome in 59 B.C. The world's first printed newspaper was a Chinese circular called *Dibao* (*Ti-pao*). The Chinese began printing *Dibao* (*Ti-pao*) from carved wooden blocks during the A.D. 700's.

The beginning of the newspaper press, as we know it today, was the newsletters or newsbooks first published in the 1400's. The earliest of these newsletters, which were often called *courants, occurrents,* or *intelligencers,* were published in Europe's commercial centres. These newsletters contained business news and news of other public events likely to interest bankers and merchants.

The newsletters were then followed by news sheets. Official news sheets began to appear during the late 1500s. *Notizie Scritte* (written notices) were posted up in public places in Venice. They could be read on payment of a coin called a *gazzetta.* The term *gazette,* a common name for early newspapers, is derived from this practice. The first regularly published printed news sheet seems to have been the *Avisa Relation oder Zeitung.* From 1609, this news sheet was published weekly in Strasbourg, then in Germany.

The 1600's. The weekly *Frankfurter Journal* is generally regarded as the world's first real newspaper. Egenolph Emmel founded it in Frankfurt, Germany, in 1615. In other countries, the first newspapers were published later in the 1600's. They included *Den Danske Mercurius* (Denmark), the *Weekly Newes* (England), the *Gazette de France* (France), the *Gazeta de México* (Mexico), the *Courant* (The Netherlands), the *Gazeta* (Spain), and the *Ordinarie Post-Tidende* (Sweden). The *Leipziger Zeitung* was published in Germany in 1660. At first a weekly, it soon became the first daily journal in the world.

The 1700's. The *Wiener Zeitung* is the oldest newspaper still in existence. It was first published in Vienna, Austria, in 1703, and has appeared continuously except during World War II. *Viedomosti,* the first Russian newspaper, was begun in 1702 on the orders of Peter the Great, to report Russia's war with Sweden. The *Daily Courant* was the first daily newspaper in Britain. The *Gaceta de Guatemala* was Guatemala's first newspaper. The *Berlingske Tidende* was one of Denmark's earliest newspapers. The *Halifax Gazette* was Canada's first important newspaper. The *Christiania Intelligentssedler* appeared in Norway, *La Gaceta de Santa Fe* in Colombia, and the *Indian World* in India. The *Gazette,* published daily since 1797 at Alexandria in Virginia, is the oldest continuously published daily newspaper in the United States. Other present-day newspapers founded in the 1700's include *The Times* in Britain and the *Neue Zürcher Zeitung* in Switzerland.

The 1800's. In the early 1800's, Australia's first newspaper, the *Gazette,* appeared. Argentina and Venezuela published their first newspapers *El Telegrapho Mercantil* and *La Gaceta de Caracas.* Some of the world's greatest newspapers were founded in the 1800s. They include *La Prensa* in Argentina, the *Daily Telegraph* and the *Manchester Guardian* (now *The Guardian*) in Britain, *Le Figaro* and *Le Temps* (now *Le Monde*) in France, the *Frankfurter Zeitung* in Germany, the *Corriere della Sera* in Italy, and the *Mainichi Shimbun* in Japan.

By the mid-1800's, newspapers were able to cover news throughout the world more quickly after the invention of the electric telegraph and the introduction of international cables. Newspaper production was speeded up by the invention of the rotary printing press, first installed by *The Times* of London and then improved on by the *Philadelphia Public Ledger* in America, and by the invention of the Linotype.

Recent trends. In some countries, high operating expenses have driven many newspapers out of business. Financial problems have hit hardest at major metropolitan newspapers, which face special distribution problems as well as increasing competition from television newscasts.

Another major trend has been the growing importance of newspaper chains. Newspaper chains, brought about through mergers, grew throughout the early 1900's. But they have bought up papers at an especially rapid rate since the 1960's. In the United States, about 60 per cent of all dailies belong to chains.

Since the 1960's, many newspapers have modernized their production facilities by installing computerized editing systems, photocomposition machines, and offset presses. Even more advanced equipment is under development. For example, some papers are experimenting with systems that use *lasers* (light amplifiers) to make printing plates. Others have begun to lay out news pages by video display terminals.

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Printing
Publishing
Reuters
Stereotyping
Tass
Telephoto
Teletypesetter
Teleprinter
United Press International
War correspondent

Newsprint. See **Paper** (Special kinds of paper).

Newt is an amphibian, like the frog, toad, and caecilian. Newts are a kind of salamander. Unlike frogs and toads, newts and other salamanders have tails, even as adults. A newt's tail may be as long as, or longer than, its body.

Newts differ from other salamanders in having a flattened tail, which helps them to swim actively in the water. Newts swim by waving their bodies from side to side, like a fish. They hold their small limbs limply at their sides while swimming. Newts lay their eggs singly in the spring, in ponds or slow rivers. In the breeding season, male newts may have bright colours (often orange) with black spots and wavy crests.

The eggs are glued to the leaves of water plants, and

The male alpine newt uses its bright coloured belly to attract the female, and to warn predators that it is poisonous.

hatch after a few weeks. Young newts have feathery, external gills through which they breathe under water.

Although newts breed in the water, they spend much of the year on dry land, often hibernating in the winter under damp logs, or stones.

Scientific classification Newts belong to the order Urodela, family Salamandridae.

Newton, a unit in the metric system, is used to measure force. Its symbol is N. One newton is the force required to increase or decrease the velocity of a 1-kilogram object by 1 metre per second every second.

The number of newtons needed to accelerate an object can be calculated by using the formula $F = ma$. The mass (m) of the object in kilograms is multiplied by the acceleration (a) in metres per second squared to determine the force (F).

The newton was named after the English scientist Sir Isaac Newton.

See also **Pascal.**

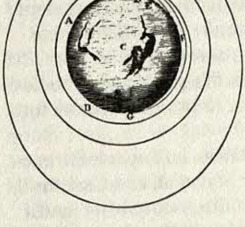
Newton, Sir Isaac (1642-1727), an English scientist, astronomer, and mathematician, invented a new kind of mathematics, discovered the secrets of light and colour, and showed how the universe is held together. He is sometimes described as "one of the greatest names in the history of human thought" because of his great contributions to mathematics, physics, and astronomy.

Newton discovered how the universe is held together through his theory of gravitation. He discovered the secrets of light and colour. He invented a branch of mathematics, *calculus,* also invented independently by Gottfried Leibniz, a German mathematician (see **Calculus**). Newton made these three discoveries within 18 months from 1665 to 1667.

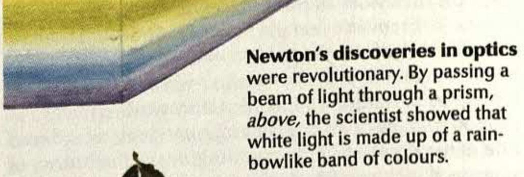
The theories of motion and gravitation. Newton said the concept of a universal force came to him while he was alone in the country. He had been forced to flee there because of the outbreak of bubonic plague in the city of Cambridge. During this time, Newton suddenly realized that one and the same force pulls an object to earth and keeps the moon in its orbit. He found that the force of universal gravitation makes every pair of bodies in the universe attract each other. The force depends on

Oil painting on canvas (about 1726) by an unknown artist; National Portrait Gallery, London

Sir Isaac Newton was a famous English scientist.



A diagram by Newton shows what happens to a projectile that is launched from a great height and at different speeds.



Newton's discoveries in optics were revolutionary. By passing a beam of light through a prism, *above,* the scientist showed that white light is made up of a rainbowlike band of colours.

A reflecting telescope designed by Newton, *left,* used a reflecting mirror instead of the traditional combination of lenses.

(1) the amount of matter in the bodies being attracted and (2) the distance between the bodies. The force by which the earth attracts or pulls a large rock is greater than the pull on a small pebble because the rock contains more matter. The earth's pull is called the *weight* of the body. With this theory, Newton explained why a rock weighs more than a pebble.

He also proved that many types of motion are due to one kind of force. He showed that the gravitational force of the sun keeps the planets in their orbits, just as the gravitational force of the earth attracts the moon. The falling of objects on earth seems different from the motion of the moon because the objects fall straight down to the earth, while the moon moves approximately in a circle around the earth. Newton showed that the moon falls just like an object on earth. If the moon did not fall constantly toward the earth, it would move in a straight line and fly off at a tangent to its orbit. Newton calculated how much the moon falls in each second and found the distance is $\frac{1}{3600}$ of the distance an object on earth falls in a second. The moon is 60 times as far from the earth's centre as such an object. Consequently, the force of the earth on an object 60 times as far away as another object is $\frac{1}{3600}$.

The Principia. Newton concluded his first investigations on gravity and motion in 1665 and 1666. Nothing was heard of them for nearly 20 years. His original theory had been based on an inaccurate measurement of the earth's radius, and Newton realized differences between the theory and the facts. Although he later learned the true value of the earth's size, he was not led to complete his investigation or to produce a book for publication.

One day in 1684, Edmond Halley, an English astronomer, Robert Hooke, an English scientist, and Christopher Wren, the architect, were discussing what law of force produced the visible motion of the planets around the sun. They could not solve this problem. Halley went to Cambridge to ask Newton about it. He found Newton in possession of complete proof of the law of gravity. Halley persuaded Newton to publish his findings. Halley paid all the expenses, corrected the proofs, and laid aside his own work to publish Newton's discoveries. Newton's discoveries on the laws of motion and theories of gravitation were published in 1687 in *Philosophiae Naturalis Principia Mathematica* (Mathematical Principles of Natural Philosophy). This work, usually called *Principia* or *Principia Mathematica,* is considered one of the greatest single contributions in the history of science. It includes Newton's laws of motion and theory of gravitation. It was the first book to contain a unified system of scientific principles explaining what happens on earth and in the heavens.

Light and colour. Newton's discoveries in optics were equally spectacular. He published the results of his experiments and studies in *Opticks* (1704).

Newton's discoveries explained why bodies appear to be coloured. The discoveries also laid the foundation for the science of spectrum analysis. This science allows us to determine the chemical composition, temperature, and even the speed of such hot, glowing bodies as a distant star or an object heated in a laboratory.

Newton discovered that sunlight is a mixture of light of all colours. He passed a beam of sunlight through a glass prism and studied the colours that were produced. A green sweater illuminated by sunlight looks green because it largely reflects the green light in the sun and absorbs most of the other colours. If the green sweater were lighted by a red light or any colour light not containing green, it would not appear green.

The study of light led Newton to consider constructing a new type of telescope in which a reflecting mirror was used instead of a combination of lenses. Newton's first reflecting telescope was 15 centimetres long, and, through it, Newton saw the satellites of Jupiter.

Early life. Newton was born at Woolsthorpe, Lincolnshire, on Dec. 25, 1642. He attended Grantham grammar school. As a boy, he was more interested in making mechanical devices than in studying. His youthful inventions included a small windmill that could grind wheat and maize, a water clock run by the force of dropping water, and a sundial. He left school when he was 14 to help his widowed mother manage her farm. But he spent so much time reading, he was sent back to school.

He entered Trinity College, Cambridge, in 1661. He showed no exceptional ability during his college career, and graduated in 1665 without any particular distinction. He returned to Cambridge as a fellow of Trinity College in 1667.

Newton became professor of mathematics at Cambridge in 1669. He lectured once a week on arithmetic, astronomy, geometry, optics, or other mathematical subjects. He was elected to the Royal Society in 1672.

Public life. Newton became active in public life after the publication of *Principia.* He became the Cambridge University member of parliament in 1689 and held his seat until Parliament dissolved the following year. He became warden of the mint in 1696. He was appointed master of the mint in 1699, a position he held until his death.

In 1699, he also became a member of the Royal Society council and an associate of the French Academy. He was elected to Parliament again from the university in 1701. He left Cambridge and settled permanently in London in 1701. He became president of the Royal Society in 1703 and was reelected annually until his death. Queen Anne knighted Newton in 1705. He died in 1727 and was buried in Westminster Abbey.

Personal characteristics. Newton did not enjoy the scientific arguments that arose from his discoveries. Many new scientific theories are opposed violently when they are first announced, and Newton's did not escape criticism. He was so sensitive to such criticism that his friends had to plead with him to publish his most valuable discoveries.

Newton was a bachelor who spent only part of his time studying mathematics, physics, and astronomy. He was also a student of alchemy, and made many alchemical experiments. He also spent a great deal of his time on questions of theology and Biblical chronology.

As a professor, he was very absent-minded. He showed great generosity to his nephews and nieces and to publishers and scientists who helped him in his work.

He was modest in his character. He said of himself shortly before his death, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Albert Einstein, the German-American physicist, rejected Newton's explanation of universal gravitation but not the fact of its operation. He said that his own work would have been impossible without Newton's discoveries. He also said that the concepts Newton developed "are even today still guiding our thinking in physics."

Related articles in *World Book* include:

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Motion
Science (The scientific revolution)
Tide

Newton-John, Olivia (1948-), an Australian singer and film star, won Grammy Awards for her records in 1973, 1974, and 1982. She appeared in the enormously successful musical film *Grease* (1978) and in the musical film *Xanadu* (1980). Newton-John was born in England. She moved with her family to Australia at the age of 5. When she was 14 years old, she formed her own musical group in Melbourne. Later, she won the Johnny O'Keefe "Sing, Sing, Sing" talent quest. She has lived and worked in England and the United States. Newton-John married Matt Lattanzi in 1984.

Newton's laws of motion. See **Motion.**

Newton's rings are a series of alternating bright and dark concentric circles that can be seen when a slightly convex piece of glass is placed on top of a flat piece of glass. If viewed in strong white light, such as sunlight, the rings show the colours of the spectrum. If the viewing light is a single colour, the bright rings will have only that colour. Newton's rings appear because of the interference of light reflected off the two glass surfaces. Light reflected off the flat surface travels slightly farther than—and interferes with—light reflected off the curved surface of the convex lens. The rings were named after the English scientist Sir Isaac Newton, who first studied them in detail.

Newtownabbey (pop. 73,718) is a local government district in Northern Ireland, administered from the market town of Ballyclare. The district lies north of Belfast and borders on Belfast Lough. In the rural north, around Ballyclare, local farmers raise dairy cattle, pigs, and sheep. The south of the district is virtually a suburb of Belfast. Many Belfast workers live in Newtownabbey. The district also produces textiles and has varied light industries.

Next of kin is a legal phrase for the closest blood relatives of a person who has died without making a will. These next of kin are entitled to share in whatever personal property the dead person owned. Laws of descent and distribution are complex and differ in various countries. *Next of kin* may also be used to mean a person's nearest relative, without regard for the legal meaning of the phrase.

Ney, Michel (1769-1815), was one of Napoleon Bonaparte's great soldiers. He served with great distinction in the campaign of 1792, when the French Army of the North defeated the Prussians and Austrians. His courage and military skill soon marked him as a most notable soldier. Napoleon made him a marshal of France in 1804. He received the title Duke of Elchingen for defeating the Austrians at Elchingen in 1805. He fought at Jena and Eylau and commanded an army at Friedland, where the French defeated the Russians in the summer of 1807. His conduct at Friedland won him Napoleon's praise. He took charge of Napoleon's army for the march into Russia in 1812, and became Prince of Moscow. Napoleon and Joachim Murat left the army after its defeat and hastened back to France (see **Murat, Joachim**). But Ney remained with the Grand Army during the terrible retreat from Russia.

When Napoleon was forced from power in 1814, Ney abandoned him, and became a supporter of King Louis XVIII, who succeeded Napoleon. But Napoleon escaped from Elba in 1815, and landed on the coast of France. Ney declared himself loyal to King Louis. He told the king that he would "bring Napoleon back in an iron cage," and started out with an army. He met Napoleon, who was marching toward Paris with a new army. But emotion swayed Ney. He embraced Napoleon, and joined him in the march on Paris. The king fled as the army approached, and Ney and Napoleon entered the capital together.

The period of Napoleon's return to power, called the *Hundred Days,* ended in defeat. Ney led the last French charge at Waterloo in 1815. But he was seized and tried for treason and rebellion. A court of his fellow officers refused to try him. But the House of Peers tried him, and condemned him to death. He was shot on Dec. 7, 1815. Ney was born in Saarelouis, in the Saar Basin, France.

See also **Napoleon I.**

NF. See **Neurofibromatosis.**

NGL. See **Natural gas liquids.**

Ngo Dinh Diem (1901-1963), was the first president of South Vietnam. He served from 1955 until a group of army officers seized control of the government and killed him in 1963.

Diem was born in central Vietnam, the son of a government official. During the 1940's, he worked for Vietnam's independence from France and opposed Communist control of Vietnam. In 1954, Communist-led rebels defeated the French forces in Vietnam. The country was then divided into two parts, South Vietnam and North Vietnam. Bao Dai, emperor of South Vietnam, appointed Diem as his prime minister. Diem was elected president when South Vietnam became a republic in 1955.

At first, Diem restored some order to his war-torn country. But he soon began ruling like a dictator, and he became increasingly unpopular. Special police units brutally crushed his opponents. Also, Diem was unable to stop *Viet Cong* (Communist-led guerrilla) attacks on villages in South Vietnam. Many of his harsh actions were attributed to advice from his brother Ngo Dinh Nhu, and his sister-in-law, Madame Nhu. Nhu and Diem were killed together.

See also **Vietnam** (History); **Vietnam War.**

Nguyen Van Thieu (1923-) became president of South Vietnam in 1967, during the Vietnam War. In April 1975—under heavy pressure from his non-Communist political opponents—Thieu resigned from office in an attempt to encourage cease-fire talks between the Communists and the South Vietnam government. But the Vietnam War ended about a week later with a Communist take-over of South Vietnam.

Thieu was South Vietnam's deputy prime minister and defence minister in 1965. From 1965 to 1967, he served as chief of state and chairman of the Directory, a 10-member executive committee in the military government that ruled South Vietnam.

Thieu was born in Phan Rang. As a military officer, he led a major attack during the military revolt that overthrew President Ngo Dinh Diem of South Vietnam in 1963. Born a Buddhist, Thieu became a Roman Catholic in 1958.

See also **Vietnam** (History); **Vietnam War.**

Niacin. See **Vitamin** (Vitamin B complex).

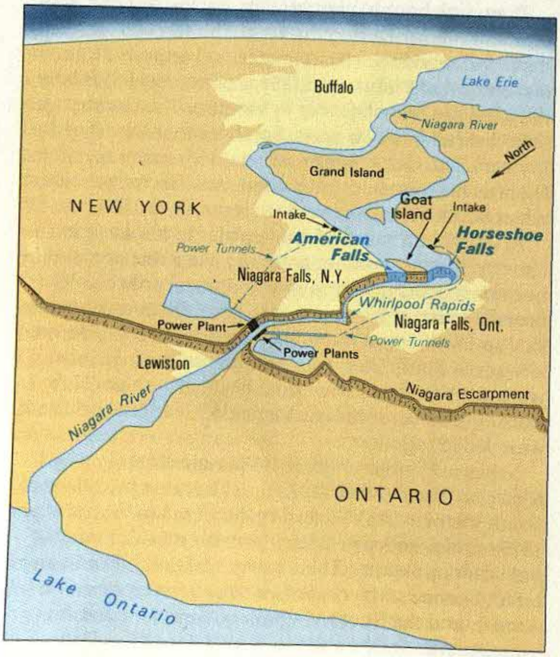
Niagara Falls is one of the most spectacular natural wonders of North America. It is on the Niagara River, about halfway between Lakes Erie and Ontario. The river forms part of the United States-Canadian border.

Niagara Falls actually consists of two waterfalls, the Horseshoe Falls and the American Falls. The Horseshoe Falls is on the Canadian side of the border in the province of Ontario. The American Falls is on the United States side in the state of New York. At night, wide beams of coloured lights illuminate the falls. About 10 million people visit Niagara Falls annually.

Description. At the falls, the Niagara River plunges into a steep, canyonlike gorge. The gorge extends beyond Niagara Falls for about 11 kilometres, to Lewiston, New York. The famous Whirlpool Rapids begin about 5 kilometres below the falls. Here, the violent current has carved a round basin out of the rocks.

About 85 per cent of the water at Niagara Falls flows over the Horseshoe Falls. The Horseshoe Falls is about 51 metres high and 792 metres wide at its widest point. The American Falls is about 54 metres high and 305 metres wide.

The gorge is about 60 metres deep and consists of layers of different kinds of stone. Hard limestone about 25 metres thick forms the top layer. It covers softer layers of limestone, sandstone, and shale. Water erodes soft stone faster than hard stone. For this reason, the top layer extends beyond the lower layers in many places. The Cave of the Winds, behind the American Falls, has been formed under an extended shelf of hard limestone.



Niagara Falls lies on the United States-Canadian border. It consists of the American Falls and the Horseshoe Falls on the Niagara River, about halfway between Lakes Erie and Ontario.

Through the years, the gorge has become longer and longer. The pounding water slowly erodes the soft underlying rock layers, which causes the unsupported hard rock ledge to collapse. Niagara Falls was originally at Lewiston, but it has gradually moved about 11 kilometres back upstream toward Lake Erie. The ledge of the Horseshoe Falls wears away at the rate of about 8 centimetres a year. The ledge of the American Falls erodes more slowly because less water flows over it. Each year, about 2.5 centimetres wears away.

Tourism. Niagara Falls attracts visitors throughout the year. However, most visitors come during the tourist season, from April 1 to October 31. Several steamers called *The Maid of the Mist* take sightseers close to the churning waters at the base of the falls. Parks line both sides of the river near Niagara Falls. Excellent views of the falls may be seen from such sites as Prospect Point, Table Rock, and Terrapin Point. Four observation towers, ranging from 85 to 150 metres high, also provide fine views of the falls.

Water flow. United States and Canadian hydroelectric plants divert some of the water through tunnels from the Niagara River before it reaches Niagara Falls. For scenic reasons, however, the amount of water that may be diverted is regulated by a treaty between the United States and Canada. The treaty states that at least 2,800 cubic metres of water a second must pass over the falls during daylight hours of the tourist season. At other times, the flow may be decreased to 1,400 cubic metres a second.

History. Niagara Falls was probably formed about 12,000 years ago, after the last great ice sheet melted from the region. The melting ice caused Lake Erie to overflow. The overflow formed the Niagara River. The river ran northward over a high cliff called the *Niagara Escarpment.* The Niagara River cut through the escarpment and, over the centuries, formed Niagara Falls.

Indian tribes lived in the Niagara Falls area long before the first Europeans arrived. The name *Niagara* comes from the Iroquois Indian word *Onguiaahra,* meaning *the strait.*

Louis Hennepin, a Roman Catholic priest who travelled with the French explorer Robert Cavelier, Sieur de La Salle, left the first written account of Niagara Falls. In a book published in 1683, Hennepin wrote: "These waters foam and boil in a fearful manner. They thunder continually."

Large numbers of tourists began visiting Niagara Falls during the 1800's. Many hotels and taverns were built on the American and Canadian sides of the falls. In addition, numerous industries began to operate along the Niagara River.

Some people believed that the rapid development of tourism and industry ruined the scenic beauty of the Niagara Falls area. In 1885, the government of New York took control of the land bordering the American Falls. It then established Niagara Falls Park, covering about 174 hectares, on the land. In 1886, Canada established

Queen Victoria Park on 79 hectares of land near the Horseshoe Falls. Since the 1880's, much more land in the Niagara Falls area has been set aside for parks, especially on the Canadian side.

Rock slides have gradually changed the appearance of Niagara Falls through the years. In 1931, about 73,000 metric tons of rock fell from the American Falls. Several years later, approximately 27,000 metric tons of rock broke off the upper edge of the Horseshoe Falls. In 1954, about 167,800 metric tons of rock tumbled from the American Falls and nearby Prospect Point.

In 1969, U.S. Army engineers built a dam to stop the flow of water temporarily over the American Falls. A board of experts from the United States and Canada then studied the rock ledge to determine how to prevent further erosion. However, the board decided that the cost of halting erosion would be too high. It recommended that nothing be done except small measures to improve public safety.

Niagara River is a short river that connects Lake Erie and Lake Ontario. The river forms part of the border between the state of New York, U.S.A., and the Canadian province of Ontario. Water from all the Great Lakes except Lake Ontario drains into the Niagara River. Most of this water drops over Niagara Falls, which is about halfway along the Niagara River's course.

The Niagara River is about 56 kilometres long. It drops 99 metres during its course, an unusually sharp descent for so short a river. The dramatic drop in elevation creates a swift current and some of the roughest rapids in the world. Hydroelectric power plants along the river produce much electricity.

Ships cannot sail the full length of the Niagara River because of the falls and rapids. However, the nearby Welland Ship Canal, built by the Canadian government, provides a route for ships travelling between lakes Erie and Ontario.

See also **Niagara Falls.**

Niamey (pop. 360,000) is the capital and largest city of Niger. The city lies on the Niger River in the southwestern part of the country. For location, see **Niger** (map).

Niamey is the chief trade and exporting centre for farm products raised in Niger. It has two market places, where people buy and sell farm products. Niamey has some small food-processing plants, but few other industries. The city's main buildings include government office buildings and a *mosque* (Muslim house of worship). Most of the people live in crowded areas along the Niger River. Niamey has a small international airport.

In the early 1900's, France took control of Niger from black Africans who had long lived there. In 1926, the French founded Niamey as the capital of their colony of Niger. Niger gained independence from France in 1960. Since then, Niamey's population has grown from about 30,000 to 360,000.

Nibelungenlied is a German epic poem written about A.D. 1200. The title means *Song of the Nibelungs.* The author is unknown but undoubtedly came from the Danube area of southeastern Germany or Austria. Several versions of the author's story exist today.

The poem tells of Siegfried, who owns the fabulous Nibelung treasure and a cloak of invisibility. He has also killed a dragon and bathed in its blood. The blood hardened Siegfried's flesh, protecting it from wounds. But a linden leaf had fallen between his shoulders while he bathed, leaving an unprotected spot on his back.

Siegfried wants to marry Kriemhild, the sister of King Gunther of Burgundy. To gain Kriemhild, Siegfried helps Gunther win the maiden Brunhild, Queen of Iceland. Brunhild will marry only the man who can overcome her in combat. So Siegfried disguises himself as Gunther, and beats Brunhild, winning her for Gunther. Years later, Kriemhild tells Brunhild that Siegfried, not Gunther, had beaten her. In revenge, Brunhild orders Hagen, one of Gunther's servants, to murder Siegfried. Hagen kills Siegfried by thrusting a spear into the unprotected spot on his back.

Several years later, Kriemhild marries Etzel, mighty king of the Huns. But she never forgets Siegfried. Kriemhild invites the Burgundians to visit her and has them slaughtered. Only Hagen survives. Kriemhild asks him to reveal where he has hidden the Nibelung treasure. When he refuses, she kills him. Hildebrand, a warrior at the court of Etzel, horrified by Kriemhild's treachery, kills her.

The background. Two actual events form the basis for parts of the *Nibelungenlied.* In A.D. 437, the Huns destroyed the Burgundians, an east Germanic tribe. The Burgundian king and members of his royal household died in the battle. The king of the Huns, Attila (called Etzel in the poem), was not connected with this event. Attila died on his wedding night in 453. Some historians are of the opinion that he was murdered by his Germanic bride.

The Nibelungen-poet clearly was not the first to deal with this story material. The Icelandic *Edda,* composed before the *Nibelungenlied,* contains *lays* (short poems) on the same themes. The early Germanic peoples also composed lays to celebrate the great heroes and events of their past. The lays were revised, and in the course of centuries the original historical events were greatly altered. Unknown poets combined the events of 437 and 453 into a single historic lay. In this lay, a Burgundian bride kills Attila to gain revenge for the death of her relatives, who had been killed by Attila's Huns.

Many of the themes and much of the plot of the older Germanic lays can still be found in the *Nibelungenlied,* but the poet changed the material. Scholars have not been able to trace the *Nibelungenlied* story of Siegfried's death to particular historical personalities and events. In fact, Siegfried's supernatural powers give his story the quality of a fairy tale.

The style. The *Nibelungenlied* is written in stanzas. Each stanza consists of four long lines of two pairs of rhymed couplets. The author shows a keen understanding of human psychology in developing the motives that cause the proud figures in the poem to act as they do. The great climaxes lie in the tense dialogues in which the rivals confront each other.

Scholars cannot say precisely what the Nibelungen-poet retained and what the poet added. The courtly aspects were probably added around 1200, when courtly culture flourished in Germany. The love between Siegfried and Kriemhild, the festivals of knights and ladies, and the many heroes reflect courtly virtues. These aspects provide the softer accents that contrast with and heighten the effect of the tragic ending.

Nicaea, Councils of. See **Nicene councils.**

The Nicaraguan countryside includes sharply rising mountains, and grazing land for cattle and other livestock. The scene above is in western Nicaragua, near the city of León.

Nicaragua

Nicaragua is the largest country of Central America in area. It extends from the Pacific Ocean to the Caribbean Sea. About three-fifths of the country's people live in a fertile region on the Pacific side. In this region is Managua, the capital and largest city of Nicaragua.

Most Nicaraguans have both *Indian*—also known as Native American or Amerindian—and Spanish ancestors. During the early 1500's, the Spaniards began arriving in what is now Nicaragua. They named the land after an Indian chief and his tribe—both called Nicarao—who lived there. The Nicarao way of life, like that of most other Indians of Nicaragua, has blended with Spanish customs and traditions. Today, only a few Indian groups still follow their traditional way of life.

Coffee and cotton are Nicaragua's leading sources of income. They are grown in the Pacific Region of western Nicaragua and in the Central Highlands. Few people live in the thickly forested Caribbean Region in the eastern part of the country.

Government

A president heads the government of Nicaragua. The people elect the president and a legislature called the National Assembly. The president appoints a Cabinet to help carry out the operations of the government.

People

The great majority of Nicaraguans are *mestizos* (people with white and Indian ancestors). Their general way of life is somewhat similar to that of Spanish-Americans in other Central American countries. Most Nicaraguans belong to the Roman Catholic Church and speak Spanish. The only Indian groups in Nicaragua that still generally speak their own languages and follow their traditional ways of life live in the thinly populated Caribbean Region. In the early 1980's, some of these Indians became involved in antigovernment activities with former supporters of the Somoza family based across the border in Honduras. Because of this, the government moved some Indian groups from their homes near the border to areas in the interior. The Indians were allowed to return to their homes in 1985. The Caribbean Region also has several black and mixed Indian-black communities that largely follow Indian customs and traditions.

About a third of Nicaragua's people are poor farmers. Many of those in the Pacific Region are peasants who work on their own farms, on cooperatives or state farms, or on large private farms. In warmer areas, agricultural workers live in palm- or metal-roofed houses. In the colder areas of the Central Highlands, farmers live in adobe (mud) houses with tile roofs. The Indians and blacks of the Caribbean Region live chiefly by farming small plots or by fishing, logging, or mining.

Facts in brief about Nicaragua

Capital: Managua.

Official language: Spanish.

Area: 130,000 km². *Greatest distances*—north-south, 472 km; east-west, 478 km. *Coastlines*—Pacific, 346 km; Caribbean, 478 km.

Elevation: *Highest*—Pico Mogotón, 2,107 m above sea level. *Lowest*—sea level along the coasts.

Population: *Estimated 1996 population*—4,569,000; density, 35 people per km²; distribution, 63 per cent urban, 37 per cent rural. *1971 census*—1,877,952. *Estimated 2001 population*—5,313,000.

Chief products: *Agriculture*—coffee, cotton, corn, bananas, beans, beef cattle, rice, sesame, sugar cane. *Manufacturing*—clothing and textiles, foods and beverages.

Money: *Currency unit*—córdoba. One córdoba = 100 centavos.

Education. Nicaraguan law requires children to go to school from the ages of 6 to 12. Before 1980, only about half the country's children did so, and most of these children lived in cities or towns. Nicaragua did not have enough schools, and many rural areas had no schools at all. But since then, the new government has built hundreds of rural schools. The government also conducted a successful literacy campaign headed mainly by young volunteer teachers.

Nicaragua has three universities. The National University of Nicaragua, in León and Managua, is the oldest and largest university. It was founded in 1812 and has more than 22,000 students.

Population. Nicaragua has a population of about 4 million people. The population increases about 3 per cent a year. To ease the pressure of this increase, the government encourages people of the Pacific Region, with loans and other help, to move to other regions of the country. The Pacific Region still has about three-fifths of Nicaragua's population, although many people have moved to northern areas of the Central Highlands.

Nicaragua has eight cities with populations of more than 20,000. In order of size, the cities are Managua, León, Granada, Masaya, Chinandega, Matagalpa, Estelí, and Jinotepe. See **Managua; León; Granada.**

Land and climate

Nicaragua has three main land regions: (1) the Pacific Region, (2) the Central Highlands, and (3) the Caribbean Region. The climate is chiefly tropical, with some differences among these regions.

The Pacific Region is largely a low area extending from Honduras to Costa Rica. Several volcanoes, some of them active, are in this low area. Lake Managua and Lake Nicaragua lie in the central and southern sections. Mountains up to 910 metres high rise along the Pacific coast. Nicaragua's largest cities and many large farms are in the Pacific Region.

The region receives about 150 centimetres of rain a year. The rainy season lasts from May to November. Temperatures average a warm but pleasant 27 °C throughout the year.

The Central Highlands make up Nicaragua's highest and coolest region. They include the country's highest point, Pico Mogotón, a peak on the border with Honduras, north of Ocotol, that rises 2,107 metres above sea level. Forests cover most of the region's slopes. Deep valleys lie between the mountains.

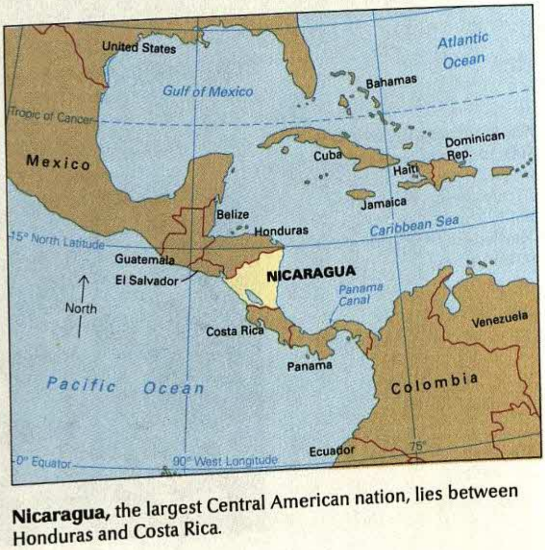
Some areas receive over 250 centimetres of rain a year. Most people live on farms in drier areas. Like the Pacific Region, the Central Highlands have a rainy season from May to November. Temperatures average 16 to 21 °C.

The Caribbean Region is mostly a flat plain, with some highlands sloping upward toward the west. Many rivers that rise in the Central Highlands flow through the plain. The region's only good farmland lies along the riverbanks. Rainforests cover most of the region. There are grasslands with palm and pine forests in the north. A number of small islands lie off the coast.

Nicaragua's flag was adopted in 1908 from that of the United Provinces of Central America. This union of the early 1800's consisted of Nicaragua and four other nations.

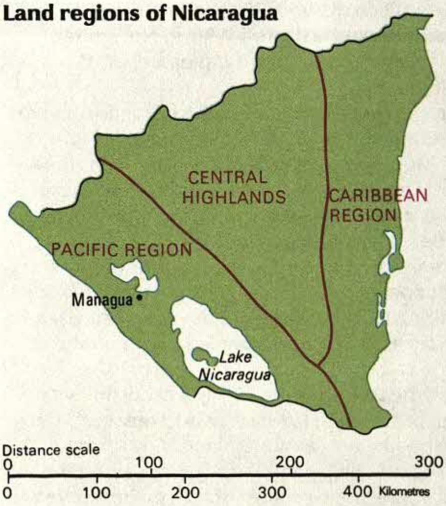
The coat of arms appears on the flag. The volcanoes stand for the Central American union, the triangle for equality, the rainbow for peace, and the cap for liberty.

Managua is the capital, largest city, and chief commercial centre of Nicaragua. The city is located in western Nicaragua.



Nicaragua, the largest Central American nation, lies between Honduras and Costa Rica.

Land regions of Nicaragua



Easterly trade winds drench the Caribbean Region with an annual average of 420 centimetres of rain, which falls throughout most of the year. Temperatures in the region average 27° C.

Economy

Nicaragua's major natural resource is the rich soil of the Pacific Region. Ash from volcanoes makes this soil especially fertile. Farming is the leading economic activity, though farmland makes up only about 10 per cent of the land area. Nicaragua has some deposits of copper, gold, and silver, but mining provides only a small part of the nation's income. Thick forests cover about half the land. Before 1979, foreign firms owned most of the mines and forests. Since then, the government has taken control of them. Many streams in the Central Highlands could furnish cheap hydroelectric power, but few have been used. The country is developing these power sources.

Agriculture. Exported farm products provide most of Nicaragua's income. Cotton and coffee are the most valuable crops. Cotton is grown in the low Pacific areas. Coffee is grown in the Central Highlands and the Pacific Region. Sugar cane is also grown there. Other farm exports include bananas and rice. Rice is the main food crop grown for use in Nicaragua. Maize and beans are grown in all regions, but chiefly in the Central Highlands. Since 1984, the government has promoted growing maize and beans on large, modern, privately owned farms in the Pacific Region.

Manufacturing. Nicaragua's industrial centre is Managua, where most of the nation's electric power is generated. As in most Central American countries, the major products are processed foods and beverages, clothing, and textiles. Other products include cement, cigarettes, and goods made of leather, petroleum, and wood. The government owns about a third of Nicaragua's manufacturing companies. The rest are privately owned—about a quarter of them by foreign firms. Manufacturing has declined since the late 1970's.

Service industries. Wholesale and retail trade form the leading service industry in Nicaragua. The marketing of farm products is the most important type of trade in the country. Government activities rank second in importance. Other service industries include finance, insurance, and property, and transportation, communication, and utilities. The Nicaraguan government controls banking and insurance.

Foreign trade. Nicaragua's chief trading partners include Japan, Mexico, and several Western European countries. Nicaragua is a member of the Central American Common Market, an economic union consisting of five nations.

Transportation. Nicaragua has some good roads, especially in the Pacific Region. The Pan American Highway is the major highway (see **Pan American Highway**). Many populated areas cannot be reached by car, and the people use mules or oxcarts. Nicaragua has an average of only about 1 car for every 100 people. There are some railways, all in the Pacific Region. Managua has an international airport.

Communication. Nicaragua has few newspapers. The largest are *La Prensa* and *El Nuevo Diario* of Mana-

Nicaraguan children outside their home in the country's Central Highlands. Most Nicaraguans are of mixed white and Indian ancestry. They make their living from farming.

gua and *Barricada,* the paper of the Sandinista National Liberation Front. Government-operated postal, telegraph, and telephone systems serve only cities and towns. Many of the country's radio stations and all of its television channels are publicly operated.

History

The Indian period. Little is known of what is now Nicaragua before the Spaniards arrived in the early 1500's. A series of Indian states occupied the Pacific Region and the Central Highlands. They built fortified towns, and had highly developed markets and a system of social classes that included slaves. Less developed Indian societies lived in the Caribbean Region.

The colonial period. In 1502, Christopher Columbus arrived at what is now Nicaragua, and claimed the land for Spain. A Spanish expedition from Panama explored the Pacific Region in 1522. Many of the Nicarao Indians who lived in the region were baptized into the Roman Catholic Church. Another expedition from Panama arrived in 1524. In 1570, Nicaragua came under the control of the Audiencia of Guatemala, a high court of Spanish judges and administrators.

The Spaniards explored the Caribbean coast of Nicaragua, but did not settle there. During the 1600's and 1700's, other Europeans—chiefly the English—occupied that region from time to time. English, Dutch, and French pirates had hideouts there, and attacked Spanish

Nicaragua map index

Cities and towns

Acoyapa	4,035	E	3
Belén	3,896	E	2
Bluefields	18,384	E	5
Boaco	8,700	D	3
Camoapa	5,513	D	3
Chichigalpa	12,601	D	1
Chinandega	45,716	D	1
Ciudad Darío	7,339	D	2
Condega	4,176	C	2
Corinto	16,526	D	1
Diriamba	17,834	E	2
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El Viejo	13,256	D	1
Esteli	21,208	C	2
Granada	58,108	E	2
Jalapa	5,347	B	2
Jinotega	14,171	C	2
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Masatepe	9,294	E	2
Masaya	48,696	E	2
Matagalpa	27,262	C	2
Nagarote	10,163	D	2
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Puerto Cabezas	7,017	B	5
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San Isidro	3,109	C	2
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Siuna	5,176	B	4
Somoto	7,250	C	2
Tipitapa	10,685	D	2

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Bay of Punta Gorda	F	5
Cabo Gracias a Dios (cape)	A	5
Coco (river)	A	4
Cordillera Darienes (mountains)	C	3
Cordillera Isabelia (mountains)	C	3
Cordillera de los Marabios (mountains)	D	1
Escondido (river)	D	4
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Isla de Ometepe (island)	E	3
Isla del Venado (island)	E	5
Lagunas de Perlas (lagoon)	D	5
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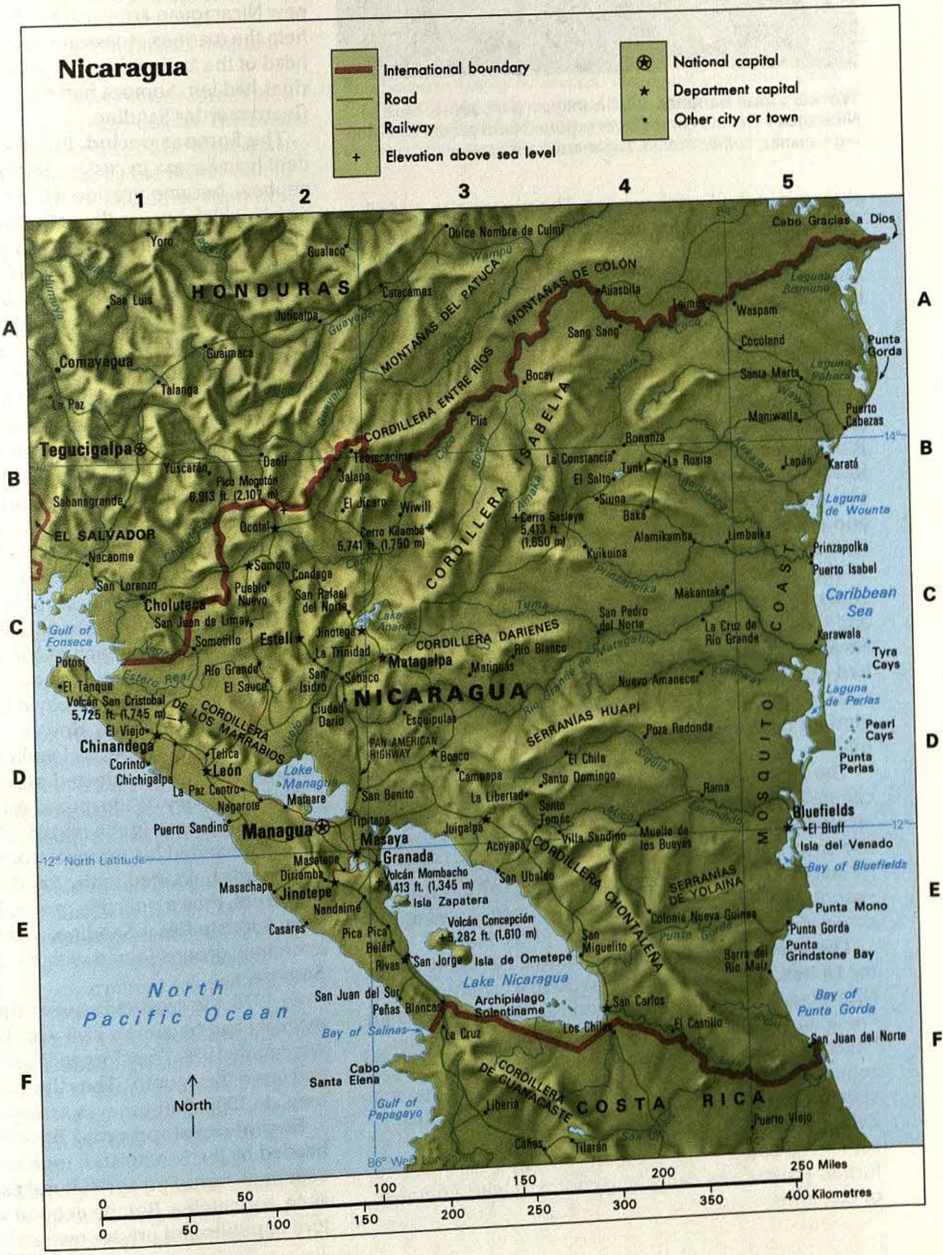
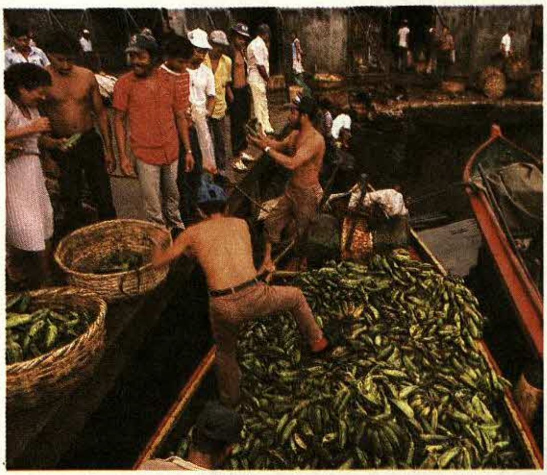
San Juan (river)	F	4
Serranías Huapi (mountains)	D	4
Tuma (river)	C	3
Volcán Concepción (volcano)	E	3



*Does not appear on map; key shows general location.
Source: Official estimates—1980 for Managua and 1979 for other places.



Workers load bananas at a Nicaraguan port, *above.* Most of Nicaragua's income comes from exported farm products, including bananas, coffee, cotton, sugar cane, and rice.

shipping in the Caribbean Sea. The pirates also raided Spanish towns to the west. During the 1700's, the English established control over the Miskito, or Mosquito, Indians of the Caribbean coast. Great Britain gave up its hold on the region to Nicaragua in the mid-1800's, under an agreement with the United States.

Independence. On Sept. 15, 1821, Nicaragua and other Central American states also declared their independence. They later became part of the Mexican empire, but broke away in 1823 and formed the United Provinces of Central America. This union generally followed liberal economic and political policies. For example, the member states established various civil rights, and ended the special rights of powerful nobles and the Roman Catholic Church.

The union began to fall apart under various pressures, including efforts by the conservative landowners and the clergy to regain their old privileges. In 1838, Nicaragua left the union. By that time, a great dispute had developed between León, the liberal centre, and Granada, the conservative centre. These two cities struggled for control of Nicaragua, and fighting often broke out.

The liberals of León asked William Walker, an American military adventurer, to help them. In 1855, Walker arrived with a band of followers and captured Granada in a surprise attack. But instead of helping the liberals, he seized control of the government in 1856. The next year, the liberals and conservatives joined forces and drove Walker from the country.

The United States and Nicaragua. For many years, the United States had wanted to build a canal across Nicaragua to link the Atlantic and Pacific oceans. In 1901, President José Santos Zelaya of Nicaragua set certain limits on U.S. rights in the proposed Nicaragua Canal zone. The United States did not accept these limits, and shifted its attention to Panama as the site of the canal. Zelaya then threatened to sell rights to the canal to some rival country of the United States. He also exerted further pressure by cancelling contracts with a number of U.S. firms.

In 1909, a revolt broke out against Zelaya, a harsh ruler. He was driven from office after the United States sided with the rebels. In 1911, U.S. banks began to lend money to Nicaragua under agreements that gave them control over its finances until the debts were paid in 1925. At the request of the banks and President Adolfo Díaz, United States marines landed in Nicaragua in 1912 to put down forces that opposed American control. The marines remained in Nicaragua almost continuously until 1933 to protect U.S. interests and supervise elections.

Rebels led by General Augusto César Sandino tried to make the U.S. forces leave Nicaragua. From 1927 to 1933, the rebels made many raids on the U.S. marines from hideouts in the mountains. The United States trained a new Nicaraguan army, called the National Guard, to help the marines. Anastasio Somoza García became head of the National Guard in 1933. In 1934, after the marines had left, Somoza had members of the National Guard murder Sandino.

The Somoza period. In 1936, Somoza forced President Juan Sacasa to resign. Somoza, who was Sacasa's nephew, became president the next year after an election in which he was the only candidate. He ruled as a dictator, and established great political and economic power for himself and his family.

From 1937 until 1979, a Somoza ruled Nicaragua either as president or as the real power behind the government. Anastasio Somoza was assassinated in 1956, and his older son, Luis, replaced him as president. Luis held the presidency until 1963. His brother, Anastasio Somoza Debayle, became president in 1967. In general, the Somozas were eager to cooperate with the United States and had support from the U.S. government.

Political stability under the Somoza family rule attracted U.S. investments, and Nicaragua's economy expanded. The 257-kilometre Rama Road was built between 1968 and 1980 with U.S. aid. It helped connect the Pacific and Caribbean coasts of Nicaragua.

In 1972, an earthquake in Nicaragua killed about 5,000 people. It destroyed much of Managua. The city was rebuilt near the site of the earthquake. Also in 1972, President Anastasio Somoza Debayle turned over formal power to a civilian junta. However, he continued to rule from behind the scenes as head of the National Guard. In 1974, Somoza was elected president for six years.

Rebel victory. Widespread protests against Somoza's rule began in the mid-1970's. Somoza's opponents demanded his removal from office. Many of the opponents belonged to the Sandinista National Liberation Front, then a guerrilla group. The group was named after Augusto César Sandino. Many other political and economic groups joined with the Sandinistas against Somoza.

By 1978, the conflict between the rebels and the government had become a civil war. The rebels won the war in July 1979. They forced President Somoza to resign and leave the country. They then set up a new government. In 1980, Somoza was assassinated in Paraguay.

Recent developments. The new government, headed by the Sandinistas, took over key parts of the economy, including agricultural exports, banking, insurance, and mining. But the economic system was a mixture of public and private ownership. The government adopted many policies designed to help the poor and improve the economy, which had been badly damaged in the civil war. But economic recovery from the war was slow, and hardships remained for many of Nicaragua's people.

In the early 1980's, internal opposition to the Sandinistas developed concerning economic policy and the type of government to be established. In 1981, the United States, charging that Nicaragua was providing weapons to rebels in other Central American countries, cut off aid to the country. In that year, former members of Somoza's National Guard and others stepped up attacks from bases over the border in Honduras. In response, the Nicaraguan government declared a state of emergency and launched a campaign to build up its military forces.

In 1983, several thousand anti-Sandinistas invaded northeastern Nicaragua. Fighting between the invaders—called *contras*—and government forces took place in Nicaragua, resulting in many deaths. The United States gave financial aid to the contras. The Nicaraguan government was given assistance by the Soviet Union, Cuba, Western European nations, and other countries.

Daniel José Ortega Saavedra became head of the Sandinista revolutionary government (see **Ortega, Daniel**). In 1984, he was elected president of Nicaragua. U.S. President Ronald Reagan charged that the Sandinistas had set up a Communist dictatorship and were providing aid to rebels in other Central American countries. In late 1983 and early 1984, the United States aided the contras in placing mines in Nicaraguan harbours. In 1985, Reagan ordered an embargo on U.S. trade with Nicaragua. Before the embargo, the United States had been Nicaragua's chief trading partner.

Some people in the United States opposed U.S. financial aid to the contras. In the 1980's, the U.S. Congress sometimes voted for and sometimes voted against further aid to the rebels. In 1986, the International Court of Justice—after reviewing complaints from Nicaragua—concluded that the United States acted illegally in helping mine the Nicaraguan harbours and providing aid to the contras. U.S. officials refused to accept the conclusion.

U.S. liberal public opinion was shocked by the discovery that in 1985 and 1986 officials of the government of President Reagan had secretly sold U.S. arms to Iran and used the money to finance the contras. The scandal, known as the Iran-contra affair, rocked the Reagan administration.

In March 1988, the Sandinistas and the contras negotiated a cease-fire. They held talks to try to resolve their differences. Although no peace agreement was reached, the level of fighting declined following the talks. But fighting resumed after the government refused to extend the cease-fire past October 31, 1989.

In elections held in February 1990, Violeta Barrios de Chamorro of the National Opposition Union (UNO), a group of 14 anti-Sandinista parties, was elected president. The government and the contras signed a cease-fire agreement in April 1990. By June 1990, the contra troops had been disbanded.

After the election of Chamorro, the United States discontinued its trade embargo with Nicaragua. But the Chamorro government still faced severe economic problems, including high inflation and poor industrial performance. Factors that contributed to these problems included the cost and damage of the Sandinista and contra war, high government spending on health and education programmes, and a lack of domestic and foreign investment.

The Somoza family controlled Nicaragua's government from 1937 to 1979. Anastasio Somoza García, *second from right,* ruled from 1937 until 1956. His sons, Anastasio Somoza Debayle, *left,* and Luis Somoza, *right,* also became president.

Related articles in *World Book* include:

Central America
Chamorro, Violeta Barrios de Córdoba
Darío, Rubén
Granada
Lake Nicaragua
León
Managua
Mosquito Coast
Ortega, Daniel
Sandino, Augusto César
Somoza García, Anastasio
United Nations (The Nicaraguan conflict)
Walker, William

Outline

- **I. Government**
- **II. People**
  - A. Education
  - B. Population
- **III. Land and climate**
  - A. The Pacific Region
  - B. The Central Highlands
  - C. The Caribbean Region
- **IV. Economy**
  - A. Agriculture
  - B. Manufacturing
  - C. Service industries
  - D. Foreign trade
  - E. Transportation
  - F. Communication
- **V. History**

Questions

How did Nicaragua get its name?
What is the main source of Nicaragua's income?
What family controlled Nicaragua from 1937 to 1979?
What is the most heavily populated part of Nicaragua?
Which two cities struggled for power in the 1800's?
What are Nicaragua's chief manufactured products?
Why is the Pacific Region's soil especially fertile?
What was the Audiencia of Guatemala?
What is Nicaragua's oldest and largest university?

Nicaragua, Lake. See Lake Nicaragua.

Nicaragua Canal. See **Nicaragua** (The United States and Nicaragua).

Nice (pop. 345,674; met. area pop. 475,507) is a resort city on the French Riviera and a Mediterranean port. It lies at the foot of the Alps near Italy (see **France** [political map]). The city has wide avenues, luxurious hotels, and villas surrounded by gardens. The Paillon River divides it into the Old Town to the east and the modern, western part. The Alps protect Nice from cold northern winds and give it a mild winter climate. Most of the people depend for their living on the tourist trade. Most tourists come during the winter holiday season between January and April, or else from July to September. The Mardi Gras, which marks the height of the Riviera Carnival, is one of the city's many winter festivals (see **Mardi Gras**).

The industries of Nice produce olive oil, perfumes, processed fruit, soap, cement, and other products. Railway lines to Marseille and to the Italian cities of Genoa and Turin pass through Nice. Greek settlers founded Nice about 400 B.C.

Nicene Councils were two councils of the Christian church held in Nicaea (Nice), in what is now northwest Turkey.

The first council was called in 325 by Emperor Constantine to settle the dispute caused by the Arian views of the Trinity. Arius was a priest of Alexandria who believed that Christ is not of the same essence as God. The council adopted the so-called *Nicene Creed.* This declared that God and Christ as God are of the same essence. The council also fixed the time for observing Easter. In some regions, the Christian Easter had been observed on the same day as the Jewish Passover. In other religions, it had been observed on the following Sunday.

The *Nicene Creed* summarized the chief articles of the Christian faith of that time. It is next oldest to the Apostles' Creed. It was adopted originally in the following form, but has been amplified since:

> We believe in one God, the Father Almighty, maker of all things, both visible and invisible; and in one Lord, Jesus Christ, the Son of God, Only begotten of the Father, that is to say, of the substance of the Father, God of God and Light of Light, very God of very God, begotten, not made, being of one substance with the Father, by whom all things were made, both things in heaven and things on earth; who, for us men and for our salvation, came down and was made flesh, was made man, suffered, and rose again on the third day, went up into the heavens, and is to come again to judge both the quick and the dead; and in the Holy Ghost.

The second council was called in 787 by the Empress Irene and her son Constantine. The Emperor Leo, Irene's deceased husband, had forbidden the use of images for any purpose. The council was called because of opposition to the decree. The empress revoked the decree after the council had laid down principles governing the veneration of images.

See also **Arianism; Easter; Iconoclast; Trinity.**

Nicholas I (1796-1855) was czar of Russia from 1825 until his death in 1855. He became known for his harsh rule, although a number of important social and economic reforms occurred during his reign.

Nicholas was born at Gatchina and was the son of Czar Paul. In December 1825, after Nicholas became czar, a group of reform-minded noblemen tried to take power. Nicholas stopped this *Decembrist Uprising,* as it is called. He executed five of the leaders and sent others to exile in Siberia or to prison.

Nicholas had been an army officer, and he tried to command Russia as if it were a regiment of soldiers. He gave a small staff great power and created a secret police force to prevent any antigovernment activity. Nicholas censored the press, persecuted Russian authors, and controlled the universities. He demanded loyalty to the czar, the Eastern Orthodox Church, and the Russian nation. In 1830 and 1831, he brutally crushed a revolution in Poland, then part of a vast Russian empire.

But Nicholas also introduced reforms. With his approval, Russia's first modern law code came into force in 1835. He also authorized improvements in the living conditions of peasants on state lands. In addition, Nicholas supported the building of Russia's first railways.

Nicholas tried to increase Russia's power in Asia and southeastern Europe. In 1828 and 1829, he fought a war with the Ottoman Empire (now Turkey) and won. He threatened the Turks again in 1853, but the United Kingdom and France aided the Turks. The Crimean War resulted, and Russia was defeated (see **Crimean War**). Nicholas died during the Crimean War.

See also **Union of Soviet Socialist Republics** (History).

Nicholas II (1010?-1061) was crowned pope in 1059. His reign is best known for the Lateran synod of 1059, which reformed the procedures for electing a pope. The synod issued a major decree that said the cardinal bishops would, in effect, propose a candidate for pope. Then all the cardinals would "elect," which really meant accept, the proposed candidate.

The newly elected pope would be presented to the people of Rome for approval. A notice would then be sent to the Holy Roman emperor for his approval. The decree's purpose was to deny the Roman nobility the right to interfere with the choice of pope. Later, it was also applied to imperial influence on papal elections. The synod also issued legislation to enforce celibacy of the clergy and to prohibit *simony,* the selling of church offices, and *lay investiture,* by which *secular* (nonreligious) rulers presented clergymen with the symbols of their offices. This authority enabled rulers to control who received those offices.

Nicholas was born in Burgundy, or possibly Lorraine, France. His given name was Gerhard.

See also **Pope** (The early Middle Ages).

Nicholas II (1868-1918), the last czar of Russia, ruled from 1894 to 1917. He had been brought up to believe that a czar must have absolute power. But he did not have the talent and drive of a strong political leader.

Nicholas was born in St. Petersburg. He succeeded his father, Czar Alexander III. His reign began during a period of industrial and cultural growth. The coal, oil, iron, and textile industries developed rapidly. Literature, science, and other branches of learning thrived. But Nicholas faced long-standing problems that he could not solve. His hopes of increasing Russian power in the Far East led to the Russo-Japanese War in 1904, which Russia lost (see **Russo-Japanese War**).

The military defeat weakened the power of Nicholas' government. Revolution broke out among many groups in 1905. Reforms were demanded by industrial workers,

Nicholas II, the last czar of Russia, and his family posed for this photograph shortly before the Russian Revolution of 1917. The czar's family included, *clockwise from lower left,* his son, Grand Duke Alexis; his wife, Empress Alexandra; and his daughters, the Grand Duchesses Maria, Tatiana, Olga, and Anastasia.

peasants, radicals, liberals, and such minorities as Poles, Finns, and Jews. In response, Nicholas promised to set up an elected assembly called the Duma and to grant personal rights to citizens. See **Duma.**

From 1906 to 1914, Nicholas' Cabinet ministers began a number of important reforms. The government expanded public education, encouraged individual ownership of land among the peasants, and gave workers some insurance against illness and injury.

Russia fought against Germany in World War I (1914-1918) and suffered severe losses. Nicholas became commander in chief, which made him appear directly responsible for military failures. His wife, the German-born Czarina Alexandra, became politically powerful, which led to stories that traitors had gained control of the government. These problems and shortages of food and fuel led to a new revolution early in 1917, and Nicholas gave up the throne.

In autumn of 1917, a group of revolutionaries called Bolsheviks seized power and took custody of Nicholas and his family. The family was reported to have been shot on July 16, 1918. Some accounts claim that Nicholas or members of his family escaped from Russia. But none of the reports has been confirmed.

See also **Rasputin, Grigori Y.; Union of Soviet Socialist Republics** (History).

Nicholas V (1397-1455) was elected pope in 1447. Nicholas was the first true Renaissance pope. He drew inspiration from intellectual developments in Florence, the leading humanist centre in Italy (see **Renaissance** [Humanism]). Nicholas spent vast sums on an important collection of ancient Greek, Roman, and early church manuscripts. These writings became the core of the Vatican Library. Nicholas sponsored many humanists in Rome as translators of Greek works into Latin, seeing the papal role not only as head of the church but also as head of Western civilization.

Nicholas aimed to once again make Rome the capital of the Christian world. He proclaimed 1450 a jubilee year, which attracted many pilgrims to Rome. He also rebuilt many structures in the city, employing leading craftspeople and artists, including the painter Fra Angelico, to decorate them. In addition, he had ambitious plans to rebuild St. Peter's Church, but was only able to reconstruct the Vatican. Nicholas was born in Sarzana, near La Spezia, Italy. His first and family names were Tommaso Parentucelli.

Nicholas, Saint (A.D. 300's), is one of the most popular saints of the Christian church. He is the patron saint of sailors, travellers, bakers, merchants, and especially children. Little is known about his life except that he was Bishop of Myra in Lycia, on the coast of Asia Minor. According to tradition, he was born in Lycia. Some legends say that he made a pilgrimage as a boy to Egypt and Palestine, that he was imprisoned during Diocletian's persecution, and released under Constantine the Great. Legends also say that Saint Nicholas attended the Council of Nicaea in 325. Many miracles were credited to him.

Much of Europe still observes December 6, the supposed day of Saint Nicholas' death, as a special holiday. For example, in Germany, Switzerland, the Netherlands, and Belgium, men in bishops' robes pose as Saint Nicholas. They visit children, examine them on their prayers, urge them to be good, and give them gifts. This custom probably originated in the legend that Saint Nicholas gave gold to each of three girls who did not have dowries and so could not get married.

Detail of a tempera painting on wood panel (late 1400's) by Carlo Crivelli; gift of the Hanna Fund, Cleveland Museum of Art, U.S.A.

Saint Nicholas

Saint Nicholas evolved into Father Christmas in Germany and Protestant northern Europe. The Dutch took "the visit of Saint Nicholas" to America. The name Santa Claus comes from *Sinterklaas,* which is Dutch for Saint Nicholas.

See also **Christmas** (Gift giving); **Netherlands** (Holidays and recreation); **Santa Claus; Saint Nicholas, Feast of.**

Nicholls, Sir Douglas (1906-1988), was the first Aborigine to be knighted and Australia's first Aboriginal state governor. He served as state governor in South Australia in 1976 and 1977. He was given his knighthood in 1972 in recognition of his work for the Aboriginal people. He was a founder member for the Aborigines' Advancement League and became a director in 1969. Douglas Ralph Nicholls was born in Cummeragunja in New South Wales. In his early life, he was a well-known boxer, runner, and footballer. Later, he became pastor of the Churches of Christ Aborigines' Mission in Fitzroy, Victoria.

Nichols, Mike (1931-), is a famous American director known for his work both in films and on the stage. Nichols won an Academy Award for directing *The Graduate* (1967), his second film. His other films include *Who's Afraid of Virginia Woolf?* (1965), *Catch-22* (1970), *Carnal Knowledge* (1971), *Silkwood* (1983), *Working Girl* (1988), and *Postcards from the Edge* (1990).

Nichols began his directing career with *Barefoot in the Park* (1963), a Broadway comedy. Nichols later directed such plays as *The Knack* (1964), *The Odd Couple* (1965), *Luv* (1966), *Streamers* (1976), *The Real Thing* (1984), and *Biloxi Blues* (1988).

Nichols was born in Berlin, Germany. He moved to the United States in 1939 and became a U.S. citizen in 1944. Nichols joined a Chicago theatre group in 1955. Later, he and another member of the group, Elaine May, formed a team that put on satirical comedy sketches.

Nicholson, Ben (1894-1982), was an English artist noted for his abstract paintings. Nicholson's most valued artistic contribution is the *relief,* a three-dimensional abstract picture created by cutting, carving, and painting flat boards. In his reliefs, Nicholson explored the interaction of form and light. His early reliefs are painted white, a colour associated with purity and with modern architecture designed in the early 1900's. His later reliefs incorporate subtle colour and texture.

Nicholson was born in Denham, near London. His father was Sir William Nicholson (1872-1949), also an artist. Ben Nicholson's early works were charming and realistic decorative paintings. He also painted still lifes that demonstrate the influence of the French artist Paul Cézanne and the cubist movement.

Nicholson, Sir Charles (1808-1903), a British doctor, helped establish Sydney University. He was appointed to the university senate in 1850 and was its chancellor from 1854 to 1862. His collection of antiquities provided the basic material for the university's Nicholson Museum. He was born at Bedales in Yorkshire, England. He landed in Sydney in 1834 and became a member of the New South Wales Legislative Council in 1843.

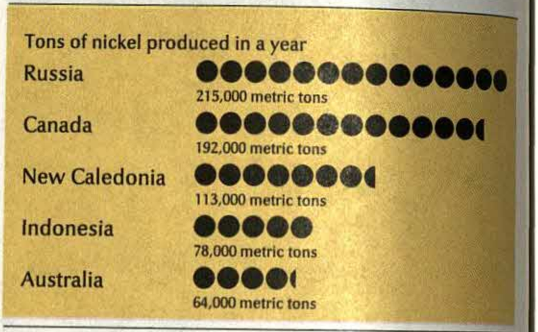
Nicholson, Jack (1937-), is an American film actor and director. He often plays a cocky, rude outsider or free-spirited individualist who rejects conventional society. Nicholson won the 1975 Academy Award as best actor for his performance in *One Flew Over the Cuckoo's Nest* and the 1983 Academy Award as best supporting actor for his performance in *Terms of Endearment.*

Nicholson was born in Neptune, New Jersey. He made his film debut in *The Cry Baby Killer* (1958) and first gained recognition in *Easy Rider* (1969). His other major films include *Five Easy Pieces* (1970), *Carnal Knowledge* (1971), *The Last Detail* (1973), *Chinatown* (1974), *The Shining* (1980), *Prizzi's Honor* (1985), *The Witches of Eastwick* (1987), *Batman* (1989), and *Wolf* (1994). Nicholson has also directed films, beginning with *Drive, He Said* (1971).

Nickel is a white metallic chemical element used in alloys. Its atomic number is 28 and its atomic weight is 58.69. Its chemical symbol is Ni. Nickel is magnetic, takes a high polish, and does not tarnish easily.

Nickel can be hammered into thin sheets or drawn into wires. One kilogram of pure nickel can be drawn into a wire 325 kilometres long. The Chinese used an alloy of nickel more than 2,000 years ago. Pure nickel was first isolated in 1751 by the Swedish scientist Axel Cronstedt.

Leading nickel-producing areas



Figures are for 1992.
Source: U.S. Bureau of Mines.

Industrial uses. Nickel is used in structural work and in electroplating chiefly because it resists corrosion. Printers often have printing plates electroplated with nickel to enable them to withstand hard use (see **Electroplating**). *Nickel peroxide* (Ni_2O_3), a nickel compound, forms the active material of the positive electrode in the Edison *accumulator* (storage battery). Nickel is also used in the nickel-cadmium accumulator (see **Battery**).

An important use for nickel is to promote certain chemical reactions by *catalysis* (see **Catalysis**). The nickel itself is not changed in the process and can be used repeatedly. Nickel is used as a catalyst in a process called *hydrogenation.* The nickel causes some organic compounds to combine with hydrogen to form new compounds. Hydrogenation produces solid vegetable oils for cooking. See **Hydrogenation.**

Nickel-iron alloys. Perhaps the largest use for nickel is as an additive to cast iron and steel. It improves the properties of these substances in many ways. It makes iron more *ductile* (easily formed) and increases its resistance to corrosion. Nickel also makes steel more resistant to impact. Manufacturers often use steel alloyed with nickel to make armour plate and machine parts.

Invar, an alloy of nickel, iron, and other metals, is valued for measuring tapes and pendulum rods. It expands or contracts very little as its temperature changes.

Monel metal is an alloy of nickel and copper used in sheet-metal work. It has an especially high resistance to corrosion. See **Monel metal.**

Nickel silver, also called *German silver,* is a nickel alloy used in tableware. See **Nickel silver.**

Mining nickel. The chief mineral ore of nickel is *pentlandite,* a mixture of sulphur, iron, and nickel. Other nickel ores include *millerite* and *niccolite.*

Before its breakup, the Soviet Union was the leading producer of nickel. It produced about a quarter of the world total. Australia, Canada, Indonesia, and New Caledonia are also important nickel-producing areas.

Nickel silver is an alloy of copper, nickel, and zinc. The alloy is also called *German silver* because it was first made in Hildburghausen, Germany. It is a yellowish metal that is harder than silver. Nickel silver tarnishes easily, but it takes a good polish. Much of the silverware used today is made of nickel silver plated with real silver. It looks like solid silver when new, but the plate wears off with use.

Vinegar and strong salt solutions may combine with nickel silver to form *toxic* (poisonous) substances that can make people ill. Silver-plated tableware should not be used with these types of liquids after the silver plate has worn off.

See also **Alloy.**

Nickelodeon. See **Film industry** (History of the cinema; picture).

Nicklaus, Jack (1940-), an American golfer, ranks among the greatest players in the history of the sport. Nicklaus was the first player to win all four of golf's major titles at least twice. He won the British Open in 1966, 1970, and 1978; the U.S. Open in 1962, 1967, 1972, and 1980; the U.S. Masters tournament in 1963, 1965, 1966, 1972, 1975, and 1986; and the U.S. Professional Golfers' Association (PGA) tournament in 1963, 1971, 1973, 1975, and 1980. Nicklaus also won the United States Amateur tournament in 1959 and 1961 before turning professional.

Jack William Nicklaus was born in Columbus, Ohio. He was nicknamed the "Golden Bear" because of his blond hair. His first professional tournament victory came in 1962 when he defeated Arnold Palmer in a playoff for the 1962 U.S. Open championship. Nicklaus has also designed a number of golf courses.

See also **Golf** (picture).

Nickname. See **Name** (Nicknames).

Nicolet, Jean (1598-1642), was an early French explorer in America. Historians believe he was the first European to enter Lake Michigan and to travel in the territory that is now the state of Wisconsin. Little was known of his explorations until the middle 1800's when an account of his western journey was found in the *Jesuit Relations.*

It is now believed that Nicolet made a voyage up through Lake Huron in a large canoe in 1634. He passed through the Straits of Mackinac and entered Lake Michigan. Nicolet's party crossed the lake to Green Bay on the west side. There they met a tribe of Winnebago Indians, with whom Nicolet made a peace treaty. They honoured him as a son of the gods. Nicolet is believed to have gone a short way inland and then to have returned to the French outposts.

Nicolet was born in Cherbourg, France, and went to America when he was 20 with explorer Samuel de Champlain. Nicolet drowned when his boat overturned on the St. Lawrence River.

Nicosia (pop. 163,700) is the capital and largest city of Cyprus, an island republic in the Mediterranean Sea. It lies in the north-central part of the island (see **Cyprus** [map]). The city serves as the business and administrative centre of the island. It is also a trade centre in the Mesaoria Plain. Goods produced in that region include almonds, fruit, olive oil, wheat, and wine.

In 1974, Turkish troops invaded Cyprus. Nicosia then was divided into a Turkish Cypriot section to the north and a Greek Cypriot section to the south. The island's main government offices are located in the southern section.

Nicotiana. See **Flowering tobacco.**

Nicotine is a chemical compound found in small amounts in the leaves, roots, and seeds of the tobacco plant. Nicotine is one of the few natural liquid *alkaloids* (see **Alkaloid**). It can also be made synthetically.

The content of nicotine in tobacco can vary from 0.2 per cent to 5 per cent. Smoking tobaccos generally contain between 1 per cent and 2 per cent nicotine. A smoker takes in about 0.05 milligram to 2 milligrams of nicotine per cigarette. The nicotine quickly becomes absorbed into the smoker's blood and reaches the brain within eight seconds after inhalation.

Pure nicotine is extremely poisonous. Even a small amount will cause vomiting, great weakness, rapid but weak pulse, and possibly collapse or even death. Nicotine is the ingredient in tobacco to which people become addicted and dependent. Doctors generally agree that use of tobacco is harmful. See **Smoking.**

See also **Tobacco** (introduction).

Nicotinic acid. See **Vitamin** (Vitamin B complex).

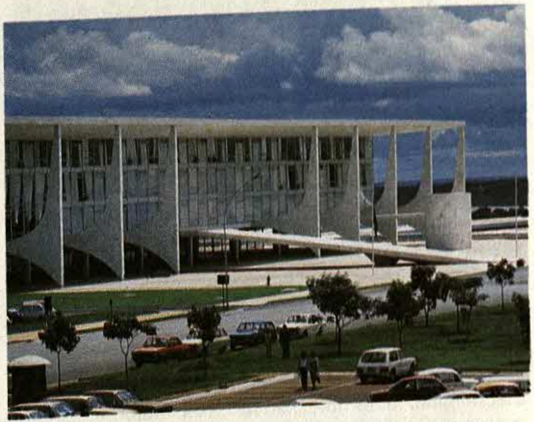
Nictitating membrane is a thin membrane under the eyelid that can be pulled over the eyeball. Birds and many reptiles have the membrane, but human beings do not have it.

Nielsbohrium. See **Element 105.**

Nielsen, Carl August (1865-1931), was one of Denmark's greatest composers. His music was largely overlooked during his lifetime but became internationally popular after his death.

Nielsen wrote in the traditional forms of the 1800's. His early works reflect the strong influence of the German composer Johannes Brahms. However, Nielsen's style grew steadily, and he eventually developed a more modern musical language, especially in his use of harmonies. Nielsen's compositions include six symphonies, symphonic poems for orchestra, and concertos for clarinet, flute, and violin. He also wrote chamber music, 10 cantatas, and works for both piano and organ. One of his last major compositions is *Piano Music for Young and Old* (1930), a set of 24 pieces in all keys. Nielsen was born near Odense on the island of Fyn.

Niemeyer, Oscar (1907-), is a Brazilian architect. He is best known as the designer of the principal buildings of Brasília, the Brazilian capital (see **Brasília**). Niemeyer often uses decorative shapes for entire buildings, and in repetitious architectural elements. He has said that his designs are inspired by Brazilian climatic and



The Presidential Palace was one of many buildings designed by Oscar Niemeyer in the 1950's for Brazil's capital, Brasília.

social conditions, and the nation's colonial baroque art heritage.

Niemeyer was born in Rio de Janeiro. His early work was influenced by brief contact with the architect Le Corbusier. An example of this work is the Ministry of Education (1937-1943) in Rio de Janeiro. It is shaped like a concrete slab, with windows set deeply into the building to provide sun shades. During the early 1940's, Niemeyer served as chief architect for Pampulha, a new residential suburb near Belo Horizonte. For a picture of his work, see **Brazil** (The arts).

Niépce, Joseph Nicéphore (1765-1833), a French scientist, invented the first photographic technique, *heliography.* Niépce began experimenting in 1816. He succeeded in making a crude photograph of a courtyard in 1826. He sensitized a metal plate with bitumen and exposed it for eight hours. This plate, the world's first photograph, is in the Gernsheim Collection at the University of Texas, in Austin, Texas, U.S.A. (see **Photography** [History; picture]). Niépce also produced photogravure plates from engravings and pioneered photomechanical reproduction methods.

In 1829, Niépce became the partner of L. J. M. Daguerre, who based his researches for his daguerreotype process on Niépce's earlier technique of heliography (see **Daguerre, Louis J. M.**). Niépce was born in Chalon-sur-Saône.

Nier, Alfred Otto Carl (1911-), an American physicist, won distinction for his development of a mass spectrograph and his use of it in nuclear research. He specialized in the study of *isotopes* (atoms of the same element with different atomic weights) and their accurate mass determination.

Nier separated a small amount of the two principal isotopes of uranium, U-235 and U-238, in 1940. This allowed physicist J. R. Dunning and his associates at Columbia University to prove that U-235 *fissions* (splits) when bombarded with slow neutrons. This discovery ranks as a milestone in the development of practical atomic energy. Nier also studied thermal diffusion, electronics, and the application of the mass spectrograph to chemistry, geology, and medicine.

Nier was born in St. Paul, Minnesota. He graduated from the University of Minnesota. He became chairman of the physics department there in 1953.

Nietzsche, Friedrich (1844-1900), was a German philosopher, poet, and classical scholar. Many philosophers, writers, and psychologists of the 1900's have been deeply influenced by him.

Nietzsche greatly admired classical Greek civilization. In his first book, *The Birth of Tragedy* (1872), he presented a revolutionary theory about the nature of Greek tragedy and civilization. He said they could best be understood as the results of a conflict between two basic human tendencies. The *Apollonian* tendency was a desire for clarity and order, represented by the Greek sun god, Apollo. The other, *Dionysian,* tendency was a wild, irrational drive toward disorder, represented by the god of wine, Dionysus.

Nietzsche criticized religion. In *Thus Spake Zarathustra* (1883-1885), he proclaimed, "God is dead." He meant that religion, in his time, had lost its meaningfulness and power over people and could no longer serve as the foundation for moral values. He believed the time had come for people to critically examine their traditional values and the origins of these values.

Nietzsche tried to begin this "re-evaluation of all values" in such works as *Beyond Good and Evil* (1886) and *Genealogy of Morals* (1887). He said that the warriors who originally dominated society had defined their own strength and nobility as "good," and the weakness of the common people as "bad." Later, when the priests and common people came to dominate society, they redefined their own weakness and humility as "good" and the strength and cruelty of the warriors whom they feared as "evil." Nietzsche criticized this second set of values because it was based on fear and resentment, and he associated these values with the Judeo-Christian tradition. He repeatedly criticized Christianity, particularly in *The Antichrist* (1895).

Nietzsche boasted that he was one of the few philosophers who was also a psychologist. Nietzsche's major psychological theory is that all human behaviour is basically motivated by the "will to power." He did not mean that people wanted only to overpower each other physically. He thought that people also wanted to gain power and control over their own unruly passions. He thought that the self-control exhibited by ascetics and artists was a higher form of power than the physical bullying of the weak by the strong. Nietzsche's ideal person, the *overman* or *superman,* is the passionate individual who learns to control passions and use them in a creative manner. Nietzsche said that people should accept and love their own life so completely that they would choose to relive it, with its joys and sufferings, an infinite number of times.

Nietzsche was born in Saxony, the son and grandson of Protestant ministers. He studied at the universities of Bonn and Leipzig. When he was only 24, he became professor of classics at the University of Basel in Switzerland. There he became the close friend of the composer Richard Wagner, but the friendship ended in hostility. In 1870, Nietzsche became a Swiss citizen. After teaching at the university for only 10 years, he retired because of poor health. He then devoted all his time and energy to his writing. In 1889, Nietzsche suffered a mental breakdown from which he never recovered.

Nietzsche has unjustly suffered notoriety as a racist, anti-Semite, and forerunner of Nazism. This is largely due to the editing of his writings and misrepresentation of his ideas by Nazi propagandists and by his racist sister Elizabeth.

Niflheim was a land of the dead in Norse mythology. Niflheim was a region of eternal ice, mist, and darkness. It lay across the river Gjol, far to the north of Midgard, where the human race lived. The chief god Odin banished the goddess Hel to Niflheim. There she became the ruler of the afterworld, which housed the souls of those who died of disease or old age. The souls of warriors killed in battle went to a place called Valhalla.

Uller, the god of winter, lived in Niflheim during the summer months. The giant serpent Niðoggr dwelt there in a turbulent spring called Hvergelmir. The deepest root of Yggdrasil, a tree that supported the world, was located in Niflheim. Bifrost, the rainbow bridge, arched over Niflheim, connecting Midgard to Asgard, the realm of the gods.

See also **Mythology** (Teutonic mythology).

Niger is a large, landlocked country in West Africa. Barren desert and mountains cover most of northern Niger. A grassy, thinly wooded plain extends along the southern border. The country, officially called the Republic of Niger, takes its name from the Niger River, which flows through its southwest corner. Niamey is Niger's capital and largest city.

The people of Niger belong to many different ethnic groups, each with its own language and customs. Almost all the people are black Africans, and a large majority are Muslims. Most of the people work as farmers and live in the south, where water and farmland are available.

Niger became an independent nation in 1960. It had been ruled by France for about 60 years before independence.

Government. The president is the most powerful official in Niger's government. The president is elected by the people to a seven-year term. The legislature, called the National Assembly, is made up of 83 members elected by the people. The Assembly elects a prime minister, and the prime minister appoints a cabinet of ministers. The prime minister and the cabinet run the daily operations of the government. Niger is divided into seven departments for the purposes of local government. Each department is managed by a *prefect* (governor). Prefects are elected by the voters in their departments.

Niger's judicial system includes local and national courts. *Quranic* (Islamic) law is widely applied in court cases involving family disputes.

People. For Niger's total population, see the *Facts in brief* table with this article. The people of Niger are called *Nigeriens.* About 98 per cent of the people are black Africans. Nonblack minorities in the population include a local white ethnic group called the Tuareg, whites from other countries, and Asians.

The major black ethnic groups in Niger include the Hausa, Djerma-Songhai, Kanuri, and Fulani. The Hausa make up about half of the population of Niger. They live mainly in the south and work as farmers. Between a quarter and a fifth of the people are members of the Djerma-Songhai ethnic group. The Djerma-Songhai are farmers and live in the southwestern corner of the country. The Kanuri make up about 5 per cent of the population. They farm the rich land in southeast Niger.

Facts in brief about Niger

Capital: Niamey.
Official language: French.
Area: 1,267,000 km². *Greatest distances*—east-west, 1,770 km; north-south, 1,328 km.
Elevation: *Highest*—Mt. Gréboun, 1,944 m above sea level.
Population: *Estimated 1996 population*—9,386,000; density, 7 people per km²; distribution, 77 per cent rural, 23 per cent urban. *1988 census*—7,249,596. *Estimated 2001 population*—10,961,000.
Chief products: *Agriculture*—beans, cassava, cotton, hides and skins, livestock, millet, peanuts, peas, rice, sorghum. *Mining*—uranium, natron, phosphate, salt, tin, tungsten.
Flag: Horizontal stripes of orange, white, and green; an orange circle on the white stripe. See **Flag** (picture: Flags of Africa).
Money: *Currency unit*—franc. One franc = 100 centimes.

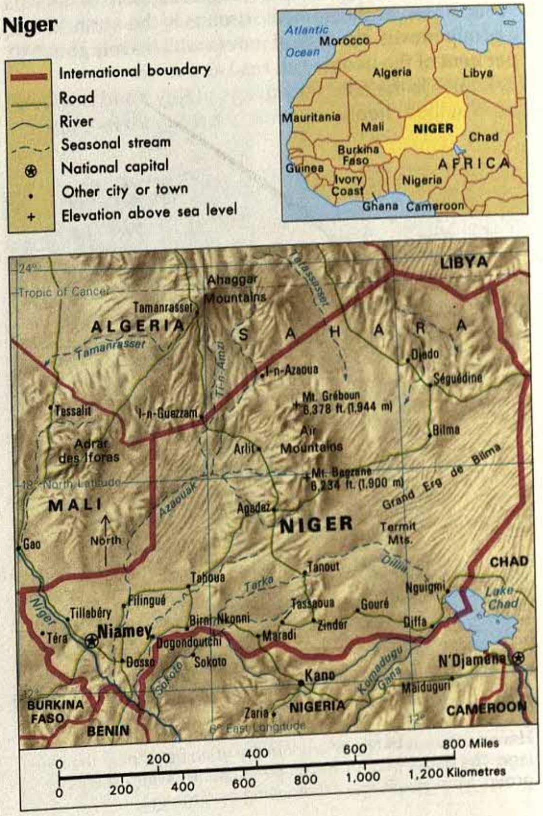
Many of the Fulani and the Tuareg are *nomadic* (travelling) people who rear livestock for food. Together they make up more than 10 per cent of the population. During the rainy season, which lasts from July to September, these two groups live in the barren desert country of northern Niger. In dry months they travel south in search of water and pastureland.

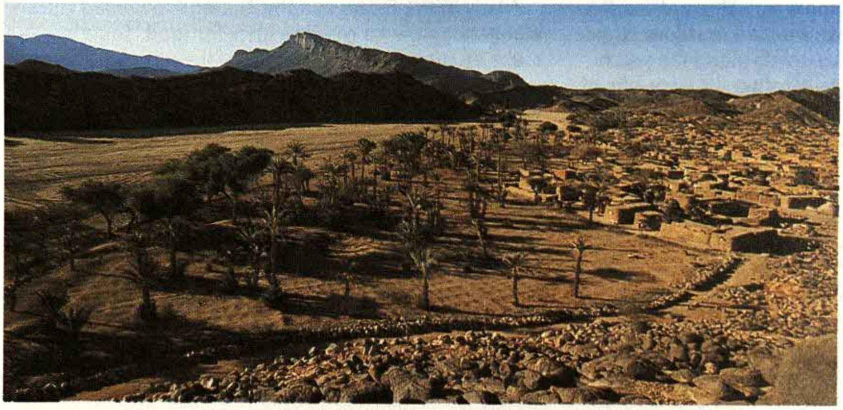
About four-fifths of Niger's people live in rural areas. Most of them grow crops and rear livestock for food and for export. Some Nigeriens who live near the Niger River or Lake Chad fish for a living. The nomadic groups rear camels, cattle, goats, and sheep. In the late 1960's and early 1970's, and again in the early 1980's, severe droughts led to the deaths of many of the nomads' animals. As a result, many nomads were forced to become farmers or move to urban areas.

About one-fifth of all Nigeriens live in cities and towns. Niamey, the capital, is the largest city by far. It has about 360,000 people. Other important cities include Agadez (Agades), Maradi, Tahoua, and Zinder. Most urban workers in Niger have jobs in the government and other services, or in business.

Houses in rural Niger are built according to the traditions of the various ethnic groups. The Hausa live in crowded villages and towns, in houses built of sun-dried mud bricks. The nomadic Tuareg live in tents made of skins or mats. The nomadic Fulani build houses out of straw and branches, and must construct new homes every time they move. The Nigerien government has built low-cost single-family houses in Niamey.

Niger





The village of Timia Aïr in Niger developed around an oasis, which is the major source of water in the region. The Aïr Mountains, in the background, receive only slightly more rain than the surrounding desert and savanna regions.

Nigeriens eat mainly grains and dairy products. Several popular dishes are made with millet and sorghum. The nomadic Fulani and Tuareg live mainly on milk products from their herds. They also trade these products for grains and vegetables.

Most Nigerien women wear long wrap-around skirts with short blouses and sandals. Men may wear trousers or knee-length shorts with loose shirts or robes. Tuareg men wear turbans with veils. The Fulani and Tuareg, who travel in desert areas, wear long, loose robes for protection from the sun.

Education in Niger is free, but many areas do not have schools. The government operates the state schools. Many places have *Quranic* schools, which teach Muslim religious knowledge. A system of "tent schools" serves the nomadic groups in the north. When a group moves, the school moves with it. Only about 10 per cent of the people can read and write.

French is the official language of Niger and is widely used in the schools. However, most Nigeriens commonly speak the language of their ethnic group, instead of French. More than 85 per cent of the population understand the Hausa language, which serves as the language of trade. The language of the Djerma-Songhai ranks as the second most widely spoken language. Some Nigeriens speak Arabic.

About 90 per cent of all Nigeriens are Muslims. A small percentage of urban dwellers are Christians, and some rural Nigeriens practise African religions.

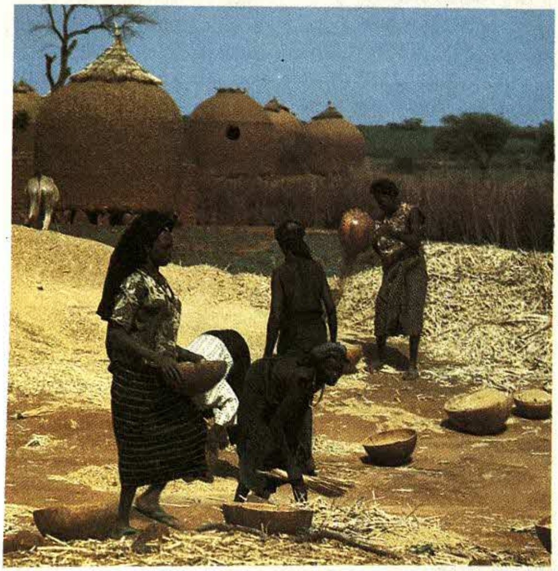
The ethnic groups in Niger have produced many kinds of crafts, music, dance, and art. Craftworkers make gold and silver jewellery, pottery, leatherwork, cloth, and wood carvings. People in both urban and rural areas enjoy traditional African music. Popular forms of recreation include cycling, basketball, and soccer.

Land and climate. Niger has an area of 1,267,000 square kilometres. Sandy plateaus and desert cover the northern two-thirds of Niger. In the centre of this region, a large area of mountain ranges called the Aïr Mountains rises above the flat landscape. These mountains include the highest peak in Niger, Mount Gréboun, which stands 1,944 metres above sea level. Less than 17.5 centimetres of rain falls each year in the mountains. The surrounding desert receives even less rain. Temperatures in the area can reach as high as 50° C.

Niger's most productive zone for herding animals and growing crops is the *savanna,* a grassy, thinly wooded plain in the south. The savanna extends from the Niger River in the west, along Niger's southern border, to Lake Chad in the east. It is one of the hottest places in the world, with average daily temperatures in Niamey reaching 35° to 38° C. Most of Niger's rain falls in the savanna area. The city of Zinder receives about 55 centimetres annually.

Niger is a landlocked nation, with no outlet to the sea. The Niger River flows for about 565 kilometres across the southwest corner of Niger. The river floods each January and February and provides irrigation water for growing crops along its banks.

Niger's plant and animal life vary from north to south. Few plants grow in the desert, except near oases, where the date palm tree is common. Such wild animals as foxes, ostriches, barbary sheep, and gazelles and other antelope live in the north. Palm, mahogany, kapok, acacia, and baobab trees grow in the south. Wild animals in the south include elephants, wart hogs, baboons, giraffes, and crocodiles.



Hausa women in Niger work in the grain fields near their village. The Hausa people make up the country's largest ethnic group. Most Hausa make their living by farming.

Economy. Niger is a developing nation and ranks as one of the poorest countries in the world. Only 3 per cent of its land is used to grow crops, and it has few natural resources. Droughts have devastated Niger's economy at various times, causing sharp reductions in crop and livestock production.

Niger's most important economic resource is uranium. The country is one of the world's leading producers and exporters of uranium. Other minerals include iron ore, phosphate, tin, tungsten, natron, and salt.

About 90 per cent of Niger's people live by farming and herding. Niger's agricultural exports include cotton, peanuts, livestock, meat, and hides. Such crops as beans, cassava, millet, peas, rice, and sorghum are grown for food. Farmers rear cattle, oxen, goats, and camels for food, export, and transport.

Poor transportation has hampered economic development in Niger. The country has no railways, and most of its roads are not paved. Less than 1 per cent of all Nigeriens own a car. Trucks carry freight, and people get around by bus or on foot. Niamey has an international airport.

Niger has an average of only 1 radio for every 23 people, and less than 1 per cent of the people own a television set. Niger has one daily newspaper. The government controls all communications media in the country.

History. About A.D. 1000, Tuareg people began moving south from the middle of the Sahara into what is now Niger. They eventually controlled the trade routes across the desert and south to the coast. In the 1400's, a Tuareg empire grew up around the city of Agadez.

The Songhai Empire became powerful in the 1400's. Its capital was Gao, in what is now Mali. During the 1500's, the empire conquered the Tuareg at Agadez, and controlled much of central and western Niger. In 1591, an army from Morocco captured Gao, and the Songhai Empire collapsed. See also **Africa** (Kingdoms in western Africa).

European explorers first arrived in Niger during the early 1800's. The French occupied parts of West Africa under agreements reached in 1885 and 1890 between the various European groups. France gained control of most of Niger by 1900. The French put down a strong resistance by Tuareg people in 1906. Niger became part of French West Africa in 1922. Niger gained independence from France on Aug. 3, 1960.

Hamani Diori, the leader of the Niger Progressive Party (*Parti Progressiste Nigérien,* or PPN), was elected Niger's first president. In the late 1960's and early 1970's, a severe drought struck Niger, causing widespread food shortages and other problems. In 1974, a group of army officers led by Seyni Kountché overthrew Diori's government. Kountché made the PPN illegal, suspended the constitution, and dissolved the National Assembly. Kountché became president of the Supreme Council (formerly called the Supreme Military Council), which holds all governing power. Kountché died in 1987.

The council chose Colonel Ali Saibou to succeed Kountché as its president. Niger's economy suffered during the 1980's because worldwide prices of uranium declined. In 1992, the country adopted a multiparty political system. Mahamane Ousmane of the Alliance of the Forces of Change, a coalition of parties, was elected president in 1993.

See also **French West Africa; Fulani; Hausa; Sahara; Tuareg.**

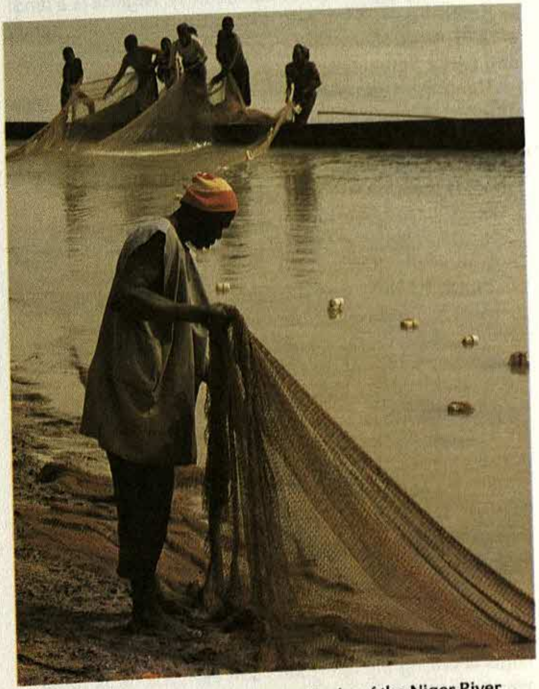
Niger River is the third longest river in Africa. Only the Nile and Congo (Zaire) rivers are longer. The Niger River flows about 4,180 kilometres in western Africa. It carries more water than any other African river except the Congo (Zaire). The Niger River drains about 1,500,000 square kilometres of land.

The Niger begins in the highlands of southern Guinea, near Guinea's border with Sierra Leone. The river then flows northeast into Mali, where it turns southeastward. After leaving Mali, the river cuts through the southwestern part of Niger and the northern tip of Benin. It then flows through western Nigeria, where it is joined by its main tributary, the Benue River. Near the coast of southern Nigeria, the Niger flows through a large delta region and empties into the Gulf of Guinea, an arm of the Atlantic Ocean.

Fishing and the transportation of passengers and freight are important activities on the Niger. Boats can navigate the river for about 1,600 kilometres in Mali and about 640 kilometres in Nigeria all year round. Rapids, waterfalls, and other obstacles prevent navigation on other parts of the Niger River.

The delta region of the Niger has major deposits of petroleum. The Niger is an important source of hydroelectric power. The Kainji Dam in Nigeria is one of the largest power projects on the river. The dam, which holds back the Niger to form Kainji Lake, produces much of Nigeria's electricity.

The Scottish explorer Mungo Park became the first European to explore the course of the Niger. Park led expeditions on the river in 1796 and 1797 and in 1805 and 1806. See also **Africa** (political map).



Fishermen with their nets on the banks of the Niger River, which flows through five countries of western Africa.

Ways of life in Nigeria present a sharp contrast between the new and the old. Many Nigerians live in modern, crowded cities, such as Lagos, the commercial centre and largest city, *left.* But most people, such as the herdsmen on the right, live in rural areas and follow ancestral traditions.

Nigeria

Nigeria, a country on Africa's west coast, has more people than any other African country. Nigeria is a land of great variety. It has hot, rainy swamplands; dry, sandy areas; grassy plains; and tropical forests. High plateaus and rocky mountains rise up in parts of the country.

The population of Nigeria consists of more than 250 different *ethnic* (cultural) groups. Most of the people live in rural areas of the country. But Nigeria also has several large, crowded cities. Lagos is Nigeria's largest city. Abuja is the country's capital.

In 1976, the government announced that it would eventually move the federal capital from Lagos to Abuja, a planned city in the centre of the country. Work began in the early 1980's, and Abuja became capital in 1991.

Most Nigerians earn their livelihoods by farming, fishing, or herding. The country is a leading producer of cacao, peanuts, and other crops. In addition, Nigeria has mineral resources, including large deposits of petroleum. Since the late 1960's, profits from Nigeria's growing oil industry have brought new wealth to the nation. Nigeria has used this wealth to develop new industry, improve its educational system, and modernize its agriculture. The income from petroleum, however, has fluctuated widely.

A number of ancient kingdoms developed in the area that is now Nigeria hundreds of years ago. Some of the kingdoms became important cultural and trade centres. The United Kingdom (UK) government gained control of Nigeria during the late 1800's and early 1900's. Nigeria was a colony and protectorate of the UK until 1960, when it gained independence.

Government

Military leaders controlled Nigeria's government from 1966 to 1979. A civilian government took control in 1979, and a Constitution was adopted the same year. The Constitution gave people the right to elect the main government officials. The government was headed by a president, who appointed a Cabinet. In 1983, however, military leaders overthrew the civilian government. In the late 1980's, the military government began taking steps to return Nigeria to civilian rule. See the *Recent developments* section of this article for details.

Facts in brief about Nigeria

Capital: Abuja.
Official language: English.
Official name: Federal Republic of Nigeria.
Area: 923,768 km². *Greatest distances*— east-west, 1,287 km; north-south, 1,046 km. *Coastline*—769 km.
Elevation: *Highest*—Dimlang Peak, 2,042 m above sea level. *Lowest*—sea level.
Population: *Estimated 1996 population*—108,320,000; density, 117 people per km²; distribution, 84 per cent rural, 16 per cent urban. *1991 provisional census*—88,514,501. *Estimated 2001 population*—125,661,000.
Chief products: *Agriculture*—beans, beef and hides, cacao, cassava, cotton, maize, millet, palm oil and palm kernels, peanuts, rice, rubber, yams. *Mining*—columbite, limestone, natural gas, petroleum, tin. *Manufacturing*—cement, chemicals, clothing, food products, textiles.
National anthem: "Arise, O Compatriots."
Money: *Currency unit*—naira. One naira = 100 kobo.

National government. A military-dominated government controls Nigeria. A Provisional Ruling Council, made up of military leaders and police officers, was formed in late 1993 to make Nigeria's laws. A cabinet, called the Federal Executive Council, carries out the laws and handles the day-to-day government activities. The Federal Executive Council has about 30 members, including both civilians and military leaders. The president is the leader of both councils. The president is the head of government and commander in chief of the armed forces.

Local government. Nigeria is divided into 30 states for administering matters not reserved to the federal government. The 30 states are divided into hundreds of local government areas. Military commanders govern these areas.

Political parties. The government allows only two registered political parties—the Social Democratic Party and the National Republican Convention. The government created both parties in 1989.

Courts. The Federal Supreme Court is the highest court in Nigeria. It consists of a chief justice and 10 judges, all of whom are appointed by the federal government. The country's judicial system also includes federal courts of appeal, state high courts of justice, magistrate courts, and district courts. Courts based on Islamic law operate in the northern part of the country, where many of the people are Muslims.

Armed services. About 120,000 people serve in the Nigerian Army. The country also has a small navy and air force, and a federal police force. All military service is voluntary.

People

Population and ancestry. For Nigeria's total population, see the *Facts in brief* table with this article. Most Nigerians live in rural areas. Since the mid-1900's, many Nigerians have moved to the cities. Lagos, the nation's commercial centre and largest city, has more than a million people. Lagos was Nigeria's capital until 1991. Four other cities in Nigeria have populations of more than 400,000. They are, in order of size from largest to smallest, Ibadan, Uyo, Ogbomosho, and Kano. See **Ibadan; Lagos.**

Almost all Nigerians are black Africans. The country has more than 250 different ethnic groups. These ethnic groups differ from one another in language and in some of their customs and traditions. The three largest ethnic groups are, in order of size, the Hausa, the Yoruba, and the Igbo (also spelled Ibo). See **Igbo.** These three ethnic groups account for about three-fifths of the total population of Nigeria.

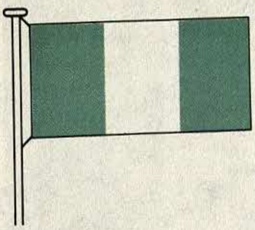
The Hausa people live primarily in northern Nigeria and in the neighbouring countries of Niger and Chad. Most of them are farmers, and many also work as craftworkers and traders. The Hausa have lived in the area for more than a thousand years. During the 1200's, the Fulani, a people who originally came from what are now Senegal and Gambia, began to settle in the Hausa territory. The Fulani took control of the region during the early 1800's. Because of the intermixing of the two peoples, the group is sometimes called the Hausa-Fulani. See **Fulani; Hausa.**

The Yoruba live mainly in the southwestern part of the country and in Benin and Togo, two nations that lie to the west of Nigeria. Many of the Yoruba live in cities and farm the land in the surrounding countryside. Several Yoruba cities, including Lagos, were founded hundreds of years ago. See **Yoruba.**

The Igbo form a majority of the population in southeastern Nigeria. Large numbers of Igbo also live in other areas of the country. During the period of British rule in the 1900's, many Igbo accepted Western education and ways of life more quickly than the other Nigerian ethnic groups and were more willing to travel. As a result, the Igbo held many important positions in business and government during the period of colonial rule.

Nigeria's other leading ethnic groups include the Nupe and Tiv of central Nigeria; the Edo, Urhobo, and Itsekiri of the Edo and Delta states; the Ijo of the Rivers State; the Efik and Ibibio of the Cross River State; and the Kanuri of northeastern Nigeria. The Kanuri trace their ancestry back to the ancient Kanem empire (see **Kanem**).

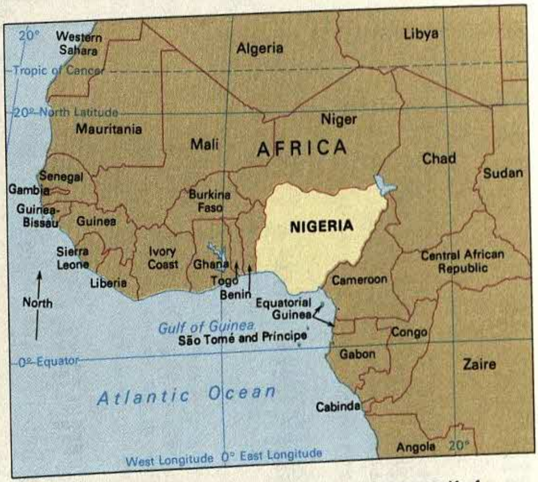
Languages. English is the official language of Nigeria and is taught in schools throughout the country. However, English is not the most commonly used language. Each of the more than 250 ethnic groups in Nigeria has its own distinct language. The three most widely used languages in the country are those of the three largest ethnic groups—Hausa, Yoruba, and Igbo.



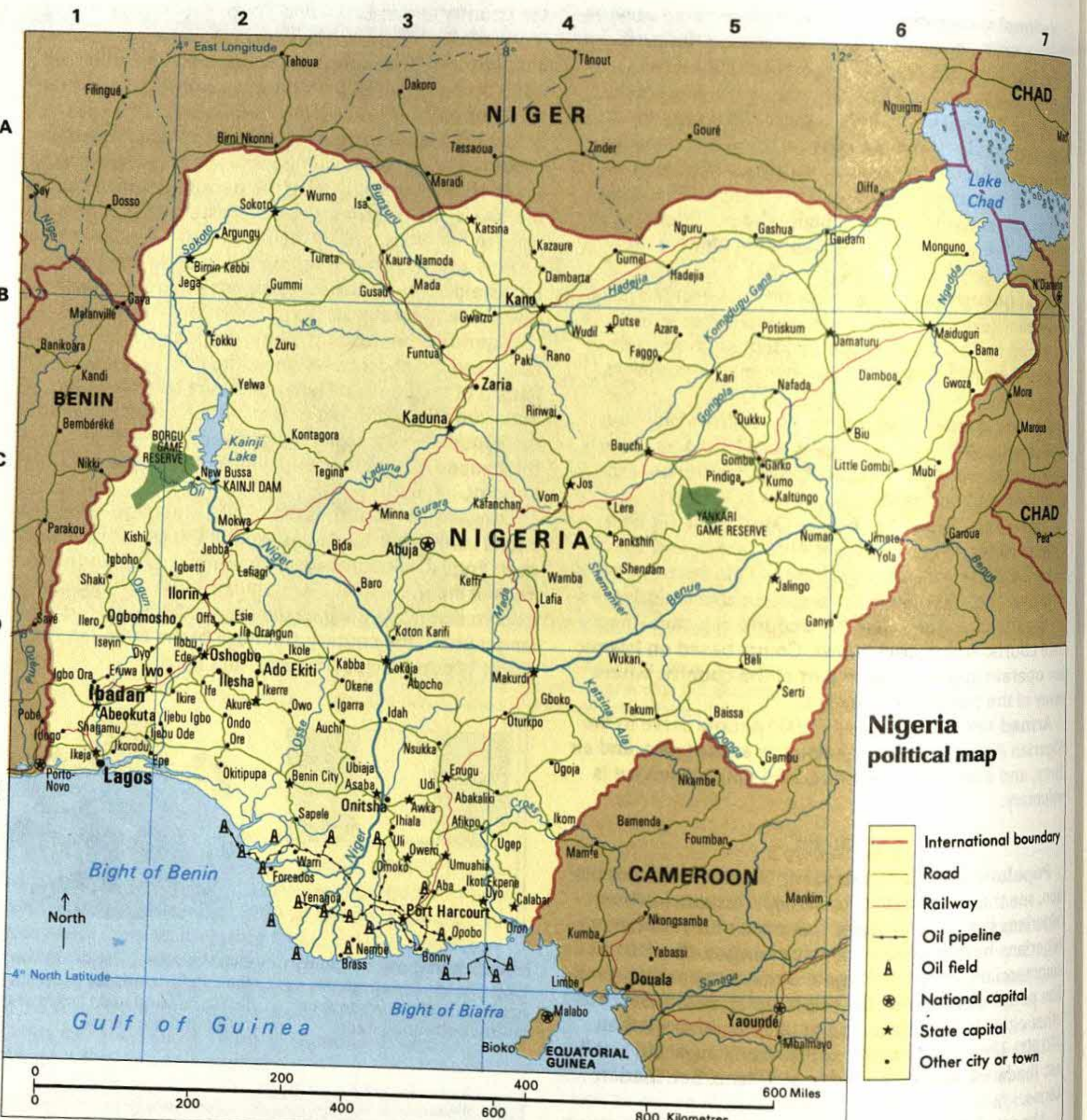
Nigeria's flag was adopted in 1960. The green represents agriculture, and the white symbolizes unity and peace.

UNITY AND FAITH PEACE AND PROGRESS

Coat of arms. The design on the shield stands for Nigeria's fertile soil and main rivers, the Niger and the Benue.



Nigeria, a large country in West Africa, lies on the Gulf of Guinea, just north of the equator.



Nigeria map index

States*

Abia	2,297,978	E	3
Adamawa	2,124,049	C	6
Akwa Ibom	2,359,736	F	4
Anambra	2,767,903	E	3
Bauchi	4,294,413	C	5
Benue	2,780,398	D	4
Bornu	2,596,589	B	6
Cross River	1,865,604	F	4
Delta	2,570,181	E	3
Edo	2,159,848	E	2
Enugu	3,161,295	E	3
Imo	2,485,499	E	3
Jigawa	2,829,929	B	4
Kaduna	3,969,252	C	3
Kano	5,632,040	B	4
Katsina	3,878,344	B	3
Kebbi	2,062,226	B	2
Kogi	2,099,046	D	3
Kwara	1,566,469	D	2
Lagos	5,685,781	E	1
Niger	2,482,367	C	3
Ogun	2,338,570	D	1
Ondo	3,884,485	D	2
Osun	2,203,016	D	2
Oyo	3,488,789	D	2
Plateau	3,283,704	C	4
Rivers	3,983,857	F	3
Sokoto	4,392,391	A	2
Taraba	1,480,590	D	5
Yobe	1,411,481	B	6

Cities and towns

Aba	216,000	F	3
Abakaliki	44,000	E	4
Abeokuta	308,800	D	1
Abuja	378,671	C	3
Ado Ekiti	265,800	D	2
Afikpo	51,000	E	4
Agege*	64,900	E	1
Akure	117,300	D	2
Asaba		E	3
Awka	68,800	E	3
Bauchi	53,300	C	5
Benin City	165,900	E	2
Bernin Kebbi		B	2
Bida	77,600	D	3
Calabar	126,000	F	4
Damaturu		B	6
Deba*	85,600	C	5
Dukku	41,000	C	5
Dutse		B	4
Ede	221,900	D	2
Effon Alaiye*	110,600	D	2
Ejigbo*	65,500	D	2
Enugu	228,400	E	3
Gombe	66,700	C	5
Gusau	114,100	B	3
Ibadan	1,060,000	D	2
Ife	214,500	D	2
Igbo Ora	52,700	D	1
Igboho	66,000	D	1
Ihiala	56,700	E	3
Ijebu Igbo	60,900	E	2
Ijebu Ode	113,100	E	2
Ijero Ekiti*	59,200	D	2
Ikare*	101,700	D	2
Ikeja	9,073	E	1
Ikerre	176,800	D	2
Ikire	62,649	D	2
Ikirun*	112,200	D	2
Ikole	55,600	D	2
Ikorodu	114,300	E	1
Ikot Ekpene	53,800	E	3
Ila Orangun	189,700	D	2
Ilawe*	114,100	D	2
Ile-Igbo*	62,900	D	2
Ilero	40,800	D	1
Ilesha	273,400	D	2
Ilobu	143,800	D	2
Ilorin	343,900	D	2
Inisa*	74,100	D	2
Iraqbiji*	56,100	D	2
Ise Ekiti*	64,000	D	2
Iseyin	157,000	D	1
Iwo	261,600	D	2
Jalingo		D	5
Jimeta	51,200	C	6
Jos	149,000	C	4
Kaduna	247,100	C	3
Kano	487,100	B	4
Katsina	149,300	B	3
Keffi	44,700	D	4
Kishi	59,800	C	1
Kumo	107,000	C	5
Lafia	75,700	D	4
Lafiagi	44,600	D	2
Lagos	1,097,000	E	1
Lakoja		D	3
Maiduguri	230,900	B	6
Makurdi	76,200	D	4
Minna	98,900	C	3
Mubi	39,600	C	6
Mushin*	240,700	E	1
Nguru	61,000	B	5
Offa	142,300	D	2
Ogbomosho	527,400	D	2
Oka-Akoko*	103,500	D	2
Ondo	122,600	E	2
Onitsha	268,700	E	3
Opobo	50,000	F	3
Oron	48,200	F	4
Oshogbo	344,500	D	2
Owerri	26,017	E	3
Owo	132,600	D	2
Oyo	185,300	D	2
Pindiga	49,700	C	5
Port Harcourt	296,200	F	3
Potiskum	43,700	B	5
Sapele	100,600	E	2
Shagamu	72,500	E	1
Shaki	125,800	D	1
Shomolu*	106,800	E	1
Sokoto	148,000	A	2
Ugep	63,400	E	4
Umuahia	40,700	E	3
Uyo	1,000,000	F	4
Warri	91,100	E	2
Yola	17,372	C	6
Zaria	274,000	C	3

*Not shown on map; key indicates general location.
Sources: 1991 census for states and Abuja; 1983 and earlier official estimates for other cities.

A majority of the people of Nigeria speak more than one language. They may use the language of their ethnic group on most occasions, and use English or another language at other times. In addition, Nigerians who are Muslims use Arabic while taking part in various religious activities.

Way of life. Most homes in rural Nigeria are made of grass, dried mud, or wood. The roofs normally consist of asbestos, corrugated metal, or thatch. A typical village consists of several *compounds* (clusters of houses). A group of related families lives in each compound. Well-to-do city dwellers in Nigeria live in modern houses or flats. The cities also have slums, where people live in mud huts that line unpaved streets. Overcrowding has become a serious problem in many Nigerian cities since the 1960's, when increasing numbers of people began moving from rural to urban areas in search of jobs and a better standard of living.

In the cities, many Nigerians wear Western-style clothing. But other city dwellers and most people in rural areas wear traditional clothing. Traditional garments for men and women in Nigeria include long, loose robes made of white or brightly coloured fabrics. The men may also wear short, full jackets with shorts or trousers. Small round caps are popular head coverings for men, and Nigerian women often wear scarves or turbans. Rural Nigerians in some parts of the country wear only a *loin cloth,* a small piece of fabric tied around the waist.

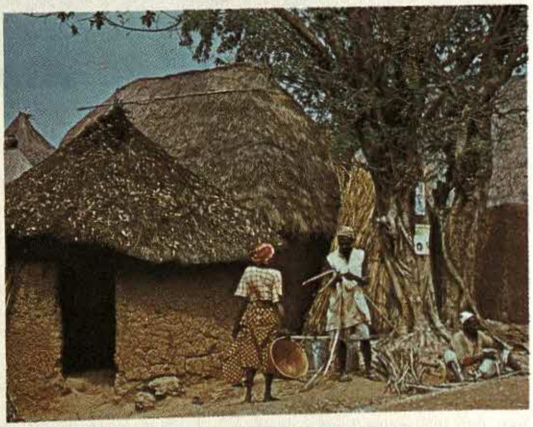
The chief foods of Nigeria include yams, maize, rice, and beans. The people also eat *plantains* (a kind of banana) and the roots of the *cassava* plant (see **Plantain; Cassava**). Nigerian food is often cooked in palm oil or peanut oil, and it may be highly seasoned with red peppers. Some Nigerian meals feature beef, chicken, fish, or lamb. But in general, most Nigerians do not eat much meat. Popular beverages in Nigeria include beer and a wine that is made from the sap of palm trees. Some city dwellers also drink coffee and tea. Nigerian Muslims who obey the laws of Islam may not drink alcoholic beverages.

Religion. Almost 50 per cent of the people of Nigeria are Muslims. They make up the majority of the population in the north. Nearly 40 per cent of the people are Christians. They live mainly in southern Nigeria. Many Nigerians, especially in the central part of the country and in rural areas, practise traditional religions based on the worship of many gods and spirits. People throughout the country may combine Christian or Muslim religious practices with traditional beliefs.

Education. About a third of the people of Nigeria can read and write. The country does not have enough schools or teachers to provide an education for all school-age children, and laws do not require school attendance. About 15 million children attend elementary schools in Nigeria. About 3½ million students attend secondary schools. Nigeria has about 25 universities. The largest is Ahmadu Bello University, in Zaria, with about 14,000 students.

In 1975, the Nigerian government announced a programme to provide free elementary school education for all eligible children. Since then, the government has built many new elementary and secondary schools in the country. It also established new teacher-training

Outdoor markets bring farmers into Nigeria's cities to sell their fruits, grains, and vegetables. The market above is in Ibadan, one of the country's most important trade centres.



A typical village in rural Nigeria consists of clusters of homes much like those above. About three-fourths of all Nigerians live in rural areas and make a living by farming, fishing, or herding.

Nigerian Muslims dressed in traditional costumes prepare to take part in a horsemanship event at the end of a religious festival. Almost 50 per cent of the people of Nigeria are Muslims.

The Niger River flows southward through west-central Nigeria. It cuts through grassland, tropical forests, and swampy plains and then empties into the Gulf of Guinea, an arm of the Atlantic Ocean. This picture shows a ferry crossing at the river's delta.

institutes, technical and vocational schools, and universities in the country.

Recreation. People in both urban and rural areas of Nigeria enjoy performances of traditional songs and dances. Films attract many people in the large cities, where radio and television are also popular. Soccer ranks as the favourite sport in Nigeria. Art festivals and special sports contests are held and popularly attended in many parts of the country.

The arts. Nigeria is famous for the variety and quality of its art. The art of Nigeria and other African countries has also influenced art movements in many other parts of the world. For example, traditional African sculpture influenced Pablo Picasso and other modern Western artists.

The oldest known African sculptures are *terra cotta* (clay) figures created by the Nok civilization in central Nigeria as early as 500 B.C. (see **Nok**). Other famous traditional sculptures include the bronze and brass figures of Benin and Ife, and the wood carvings of the Yoruba people (see **Benin; Ife**). Various peoples who live in the forest areas of Nigeria are known for their elaborately carved wooden masks. Most of the traditional Nigerian painting is done on sculptures and textiles, or as body decoration.

Nigerian music often features drums, xylophones, and various string and wind instruments. Dance and dramatic performances are popular forms of entertainment in Nigeria. Many of these performances portray themes related to traditional beliefs or the everyday life of the people.

Most of Nigeria's traditional literature is oral, rather than written. Popular forms of such literature include chants, folk stories, proverbs, and riddles. During the mid-1900's, many Nigerian authors began to write novels, stories, and poetry. These works were written in English and in local languages. In 1986, Nigerian playwright, poet, and novelist Wole Soyinka became the first African writer to win the Nobel Prize for literature.

The land and climate

Land regions. Nigeria covers 923,768 square kilometres. The country can be divided into 10 land regions. They are: (1) the Sokoto Plains, (2) the Chad Basin, (3) the Northern High Plains, (4) the Jos Plateau, (5) the Niger-Benue River Valley, (6) the Western Uplands, (7) the Eastern Highlands, (8) the Southwestern Plains, (9) the Southeastern Lowlands, and (10) the Niger Delta.

The Sokoto Plains occupy the northwestern corner of Nigeria. Several rivers flow across the flat, low-lying plains and flood the area during the rainy season. The floodwaters deposit fertile soil that allows farmers to grow various crops in the area. But the floods also occasionally destroy homes and fields.

The Chad Basin extends across northeastern Nigeria, south and west of Lake Chad. Sandy ridges cut across parts of the low-lying basin. During the rainy season, parts of the region become swampy. But long dry spells occasionally cause serious droughts in the region. Short grasses and thinly scattered trees grow in the Chad Basin.

The Northern High Plains cover almost a fifth of Nigeria's total area. They consist largely of flat grasslands, with a few hills and granite ridges. Most of the plains area has an elevation of about 762 metres above sea level.

Several branches of the Niger River have their source in the Northern High Plains. These branches include the Gongola, Sokoto, and Kaduna rivers. They flow gently across the plains and form beautiful waterfalls as they tumble into deep gorges in parts of the region.

The Jos Plateau lies near the centre of Nigeria. It rises sharply from the surrounding plains. Parts of the region are more than 1,500 metres above sea level. Dairy cattle graze on the plateau's grasslands, and the area also has important tin mines.

The Niger-Benue River Valley forms an arc across central Nigeria, from east to west. The Niger River flows southeastward from Benin through west-central Nigeria. The Benue River cuts across east-central Nigeria. The two rivers meet near the centre of the country and flow southward to the Niger Delta. Grasslands, palm forests, and swampy plains cover parts of the valley. Other areas are marked by rugged, rocky hills.

The Western Uplands, also known as the Plateau of Yorubaland, lie about 300 to 610 metres above sea level in west-central Nigeria. Dome-shaped granite hills dot the grassy plains of the uplands.

The Eastern Highlands lie along the eastern border of Nigeria. They consist of plateaus and low, rocky mountains and hills. Much of the region is more than 1,200 metres above sea level. Dimlang Peak, the highest point in Nigeria, rises 2,042 metres above sea level in the Shebshi Mountains.

The Southwestern Plains consist of a heavily forested area that slopes gently northward from the Gulf of Guinea, an arm of the Atlantic Ocean. Swamps and lagoons cover much of the coastal region. Lagos, the largest city of Nigeria, occupies several islands in the Lagos Lagoon.

The Southeastern Lowlands resemble other parts of southern Nigeria, with swamps and forested plains covering much of the region. In the northwestern part of this region, however, steep-sided plateaus rise up to about 300 metres above sea level.

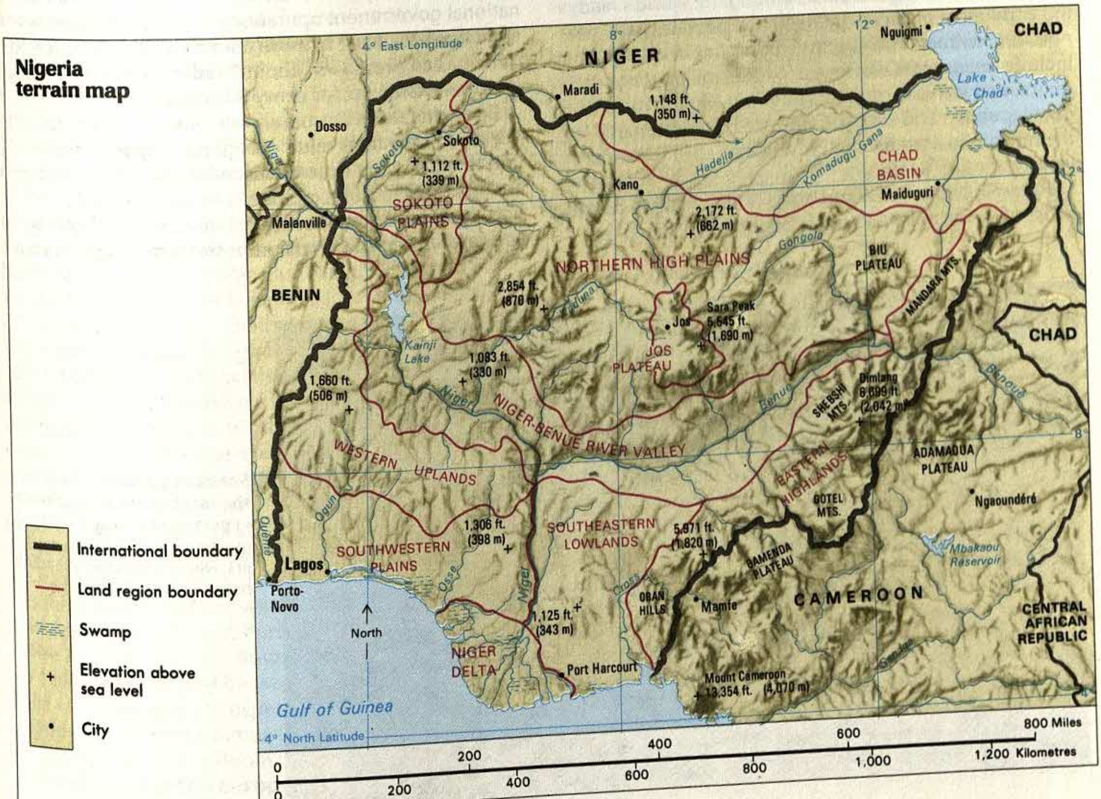
The Niger Delta forms the southernmost region of Nigeria, along the Gulf of Guinea. It consists of deposits of clay, mud, and sand at the mouth of the Niger River. Lagoons and mangrove swamps cover much of the region. This area is also the site of Nigeria's important petroleum deposits.

Climate. Most of Nigeria has a tropical climate, with warm temperatures throughout the year. The north is generally hotter and drier than the south. The average annual temperature in the north is about 29° C, but daily temperatures may rise above 38° C. The average annual temperatures in the Jos Plateau in central Nigeria and the Eastern Highlands are considerably lower, because of the altitude. The average annual temperature in the humid south is about 27° C.

Southern Nigeria receives far more rainfall than the northern part of the country. The coastal areas of Nigeria have an average annual rainfall of about 381 centimetres. Parts of the north receive only about 64 centimetres of rainfall annually. The rainy season lasts from April to October in most parts of Nigeria, though it usually extends for a longer period of time in the south.

Economy

Nigeria has a developing economy based on agriculture and mining. Agriculture employs about two-thirds of all Nigerian workers, but it accounts for only about one-fifth of the total value of Nigeria's economic production. Since the late 1960's, the development of the oil in-


Nigeria terrain map

dustry has made mining the fastest growing part of the economy. In the early 1960's, mining accounted for less than 2 per cent of the value of economic production. Today, it accounts for about 70 per cent of the value of production, and revenue from oil exports provides the government with its chief source of income.

Nigeria's factories produce a wide variety of goods. However, manufacturing employs only about 10 per cent of the country's work force. Manufacturing also accounts for less than 10 per cent of the value of Nigeria's economic production.

The federal and state governments of Nigeria control such areas as communication, transportation, and electric power production. Most businesses and industries are privately owned, but the federal government shares in the ownership of some. The government issues National Development Plans, which establish goals for economic growth.

Natural resources. Nigeria has a variety of natural resources. More than half of Nigeria's land is suitable for farming and grazing. However, only about 15 per cent of the country's total area is actually used for growing crops. Forests cover about one-third of Nigeria. The country's lakes, rivers, and streams provide an abundance of fish.

Petroleum is Nigeria's most valuable natural resource. Large oil fields lie in southwestern Nigeria and offshore in the Gulf of Guinea. The Jos Plateau of central Nigeria has important deposits of tin and columbite, a mineral that is used in the production of certain kinds of steel. Nigeria's other important natural resources include coal, iron ore, lead, limestone, natural gas, and zinc.

Agriculture. Nigeria ranks among the world's leading producers of cacao, palm oil and palm kernels, peanuts, and rubber. The country's other important crops include beans, cassava, maize, cotton, millet, rice, sorghum, and yams. Farmers throughout Nigeria raise goats, poultry, and sheep. Cattle are raised primarily in the north. Nigerian fishing crews catch shrimps and a variety of other seafoods.

Farms in Nigeria average only about 1 hectare in size. Most of the farmers use old-fashioned tools and methods. The government sponsors programmes to distribute fertilizer, insecticides, and new varieties of seeds to farmers.

Mining. Nigeria ranks as one of the world's leading producers and exporters of petroleum. Foreign oil companies operate most of the wells, but they pay the Nigerian government more than half their profits. In 1971, the government established a national oil corporation to explore for and produce oil. That same year, Nigeria joined the Organization of Petroleum Exporting Countries (OPEC).

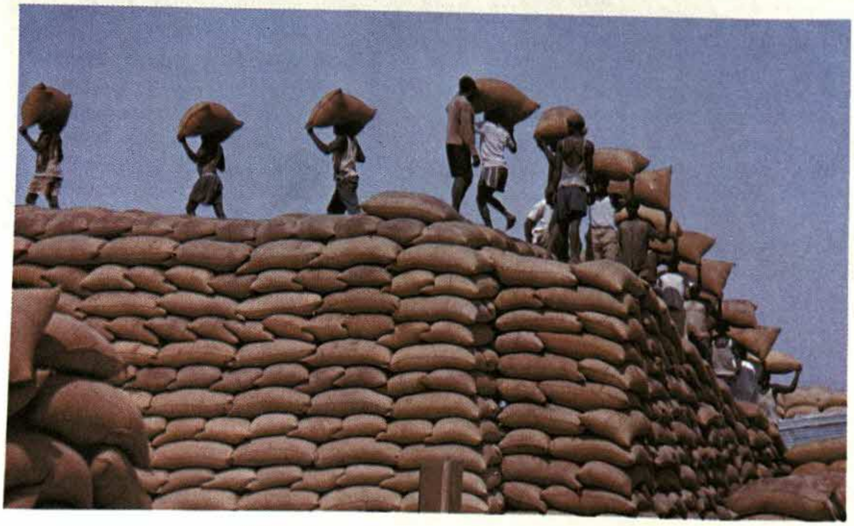
In addition to petroleum, Nigeria produces coal, columbite, gold, iron ore, lead, limestone, natural gas, and zinc. The country also ranks as an important source of tin.

Manufacturing. Leading industries in Nigeria produce cement, chemicals, clothing, fertilizers, food products, leather goods, timber, metal products, and textiles. In addition, the country has motor vehicle assembly plants, petroleum refineries, steel mills, and factories that process rubber.

Transportation and communication. Railways and paved roads link Nigeria's major cities. But many of the country's roads are unpaved and rutted. Less than 1 per cent of all Nigerians own a car. Buses and taxis—often jammed with passengers—operate along the main roads. Nigeria's chief ports are Lagos and Port Harcourt. Lagos and Kano have the country's largest airports. Nigeria Airways provides frequent domestic and international service.

More than 20 daily newspapers, representing a variety of political opinions, are published in Nigeria. The national government operates radio and television systems that broadcast in more than a dozen languages. Nigeria has an average of about 1 radio for every 6 people and 1 television set for every 50 people.

Foreign trade. Petroleum accounts for more than 90 per cent of the total value of Nigeria's exports. In addition to oil, Nigeria exports cacao beans, rubber, timber, and tin. Chief imports include cement, chemical products, food products, machinery, manufactured goods, and textiles. Nigeria's most important trade partners are



Sacks of peanuts, ready for shipment to market, are piled in pyramid form by a continuous stream of Nigerian workers. Nigeria ranks as a leading peanut-growing country.

A drilling platform, *above,* sinks an oil well into the Niger Delta. Nigeria is a world leader in the production of petroleum, its most valuable natural resource.

Brazil, France, Germany, Japan, Korea, the Netherlands, the United Kingdom, and the United States.

History

People lived in what is now Nigeria thousands of years ago. In parts of Nigeria, archaeologists have found stone tools that are 40,000 years old. Human skeletons, rock paintings, and other remains of prehistoric settlements have also been found.

The Nok civilization flourished in what is now central Nigeria from about 500 B.C. to A.D. 200. The clay figures produced by this civilization are among the oldest known examples of African sculpture. See **Nok.**

Early kingdoms. The kingdom of Kanem developed in what is now Chad during the A.D. 700's. By the 1300's, Bornu (now called Borno), in what is now northeastern Nigeria, had become the political centre of the kingdom. The Kanem-Bornu kingdom traded with countries in Africa, Asia, and Europe. See **Kanem.**

After about A.D. 1000, a number of Hausa states grew up in the region west of Bornu. Some of these states, such as Kano and Katsina, traded with other countries in North Africa and the Middle East. Kano, Kebbi, and some other Hausa states became part of the Songhai Empire, a west African state that flourished during the 1400's and 1500's (see **Songhai Empire**). During the early 1800's, Usuman dan Fodio (also called Uthman ibn Fudi), a Fulani who was a Muslim religious leader, declared war on the Hausa states. His forces gained control of almost all northern Nigeria except Bornu. He formed the area into a Muslim empire called the Sokoto Caliphate.

In the south, the Yoruba people had established an important cultural centre at Ife as early as A.D. 1000. Yorubas from Ife later founded states in various parts of the surrounding territory. The most important of these was the kingdom of Oyo, which extended into what is now the country of Benin during the 1700's.

The kingdom of Benin flourished from the 1400's to the 1600's. It developed between Lagos and the Niger Delta and grew into a prosperous trade centre. The kingdom also became famous for its sculptures of brass, bronze, and ivory. See **Benin** (former kingdom).

The coming of the Europeans. The Portuguese were the first Europeans to reach Nigeria. They established a trade centre near Benin in the late 1400's and developed a trade in slaves with the African chiefs. British, Dutch, and other European traders later competed for control of the trade. By the 1700's, the leading slave traders on the Nigerian coast were from Britain (now the United Kingdom).

In 1807, the British government outlawed the slave trade. Britain signed treaties with other European countries and with local African rulers in an attempt to end the trade. British ships travelled along the Nigerian coast and captured ships that carried slaves. The British then set the slaves free at Freetown, in Sierra Leone. British missionaries converted many of the freed slaves to Christianity. Some of the freed slaves later returned to Nigeria and helped the British spread Christianity along the coastal areas and in the southwest.

British rule. After 1807, British traders began to deal in palm oil and other agricultural products of the Nigerian coastal region. They explored the Niger River and other waterways in search of valuable natural resources. In 1851, Britain seized the port of Lagos. It became a British colony in 1861.

During the late 1800's, Britain established protectorates in parts of southern Nigeria. A British trading firm called the Royal Niger Company ruled most of northern Nigeria until 1900. That year, the British government made the region the Protectorate of Northern Nigeria. In 1906, all of southern Nigeria, including Lagos, became the Colony and Protectorate of Southern Nigeria. Nigerians in many areas, especially in the north, fought against the establishment of British rule. But the British defeated them. In 1914, Britain joined the northern and southern regions into the Colony and Protectorate of Nigeria.

Independence. During the 1920's, Nigerians began to demand representation in the British colonial government. At the same time, rivalries between the various peoples of Nigeria caused disunity in the country.

In 1946, Britain divided Nigeria into three regions—north, west, and east. Each region had an assembly composed of Nigerian and British members. The assemblies acted as advisory bodies to the central government in

Important dates in Nigeria

c. 500 B.C.-A.D. 200	The Nok civilization thrived in what is now central Nigeria.
c. A.D. 1000-1400's	Various kingdoms, including Benin, Kanem-Bornu, Ife, and the Hausa states, began to develop in different parts of Nigeria.
Late 1400's	The Portuguese became the first Europeans to reach Nigeria.
1851	Britain seized control of Lagos.
1914	The British formed the Colony and Protectorate of Nigeria.
1960	Nigeria became an independent federation.
1966	In January, military leaders overthrew Nigeria's government. In July, a second revolt established a new military government in Nigeria.
1967	Nigeria's Eastern Region declared itself an independent republic called *Biafra.* Civil war broke out between Biafra and the rest of Nigeria.
1970	Biafra surrendered, and the civil war came to an end.
1979	Civilian rule was restored in Nigeria.
1983	Military leaders took control of Nigeria's government.

An independence ceremony attended by representatives of Britain marked the opening of Nigeria's Federal Parliament in Lagos. Nigeria gained independence from Britain in 1960.

Lagos. A Constitution adopted in 1954 gave the assemblies increased powers and established Nigeria as a federation. Sir Abubakar Tafawa Balewa, a northern leader, became the federation's first prime minister in 1957. On Oct. 1, 1960, Britain granted Nigeria independence. Balewa remained prime minister.

In 1961, the United Nations (UN) organized a referendum in western Cameroon, a UN trust territory that bordered Nigeria on the east. As a result of the referendum, the northern part of the territory joined Nigeria, and the southern part joined Cameroon.

During the early 1960's, various ethnic groups competed for political power within Nigeria's three regions. In 1963, a Mid-Western Region was created out of the Western Region. People in the Northern and Eastern regions also demanded separate political units.

At the same time, different groups competed for control of the central government. The people of southern Nigeria, especially the Igbo, resented the power of the Hausa people of the north. The northerners controlled the central government because the north had more people than the other regions. Charges of dishonesty in a 1964 federal election and a 1965 regional election led to violent riots and added to the turmoil.

Civil war. In January 1966, a group of army officers, mainly Igbo, overthrew the central and regional governments. They killed Prime Minister Balewa and the prime ministers of the Northern and Western regions. General Johnson Aguiyi-Ironsi, commander of the army and an Igbo, took control of the government.

In May 1966, Aguiyi-Ironsi abolished the federal system of government. He set up a strong central government and appointed many Igbo as advisers. Many northerners feared that these actions would give the Igbo control over the entire country. Riots broke out in the north, and thousands of Igbo were killed.

In July 1966, a group of northern army officers revolted against the government and killed Aguiyi-Ironsi. Yakubu Gowon, the army chief of staff, became head of a new military government. But Colonel Odumegwu Ojukwu, the military governor of the Eastern Region, refused to accept Gowon as head of state.

In 1967, Gowon replaced the country's 4 political regions with 12 states, in order to give some of the smaller ethnic groups more political power. Ojukwu refused to accept the division of the Eastern Region into three states. On May 30, 1967, he declared the Eastern Region an independent republic called *Biafra.* Civil war between Biafra and the rest of Nigeria broke out in June 1967. Biafra surrendered in January 1970.

Recent developments. The civil war caused widespread death and destruction in southeastern Nigeria. Beginning in 1970, the government sponsored reconstruction and relief programmes. Many Igbo, including some who had fought with the rebel forces, were given government positions.

During the early 1970's, Nigeria's growing oil industry provided the country with an important source of wealth. Oil profits enabled the government to plan development programmes to improve the standard of living of all Nigerians. But in 1975, military leaders overthrew General Gowon. General Murtala Ramat Mohammed became head of state and commander in chief of the armed forces. In 1976, a group of military officers tried to overthrow the government. They failed, but killed General Mohammed. Lieutenant General Olusegun Obasanjo succeeded him. Also in 1976, Nigeria increased its number of states from 12 to 19. Military rule ended in 1979. The people elected a civilian government to replace the military government. Shehu Shagari became president. He was reelected in 1983.

The wealth that Nigeria gained from its oil exports in the 1970's attracted many people from neighbouring lands. These people came to Nigeria to find work. But in the early 1980's, declining oil prices began to hurt Nigeria's economy. In 1983 and again in 1985, the government ordered illegal foreign residents to leave.

In 1980, the Nigerian government began building a new city called Abuja near the centre of the country to replace Lagos as the capital. Abuja became the official capital in 1991.

In December 1983, the military overthrew the civilian government. Major General Mohammed Buhari became head of a new military government. In 1985, he was overthrown by other military leaders. Major General Ibrahim Badamosi Babangida replaced him as head of the military government. Elections for a new National Assembly took place in 1992. Elections for a civilian president were held in June 1993. Babangida cancelled the presidential election results, however, and many Nigerians rioted in protest. Nigerian workers went on strike to emphasize their demand for democracy.

In November 1993, General Sani Abacha, a member of Babangida's government, overthrew Babangida and declared himself president of a provisional government. He dissolved the National Assembly, outlawed political parties, and dismissed all elected officials of Nigeria's local governments.

Related articles in ***World Book*** include:

Abuja
Africa (pictures)
Benin (kingdom)
Fulani
Hausa
Ibadan
Igbo
Lagos
Yoruba

Outline

I. Government

II. People

- A. Population and ancestry
- B. Languages
- C. Way of life
- D. Religion
- E. Education
- F. Recreation
- G. Arts

- **III. The land and climate**
  - A. Land regions
  - B. Climate
- **IV. Economy**
  - A. Natural resources
  - B. Agriculture
  - C. Mining
  - D. Manufacturing
  - E. Transportation and communication
  - F. Foreign trade
- **V. History**

Questions

What are the three largest ethnic groups of Nigeria?
What was the Sokoto Caliphate?
When did the Nok civilization exist? Why is it famous?
What are Nigeria's chief agricultural products?
What events led to the Nigerian civil war?
When did Nigeria gain independence from Britain?

Night. See Day.

Night blindness. See **Blindness** (introduction).

Night heron is one of several species of herons that get their name because they hunt mainly at night. They have large eyes, and thicker bills and shorter legs than other herons. The *black-crown night heron* is the most widely distributed species, found throughout Europe, Africa, Asia, and the Americas. It is about 60 centimetres long with a black head and back, greyish tail and wings, and white throat, breast and forehead. It nests in colonies in trees and reeds.

The equivalent Australasian species is the *Nankeen night heron.* The *boat-bill heron* has a slipper-shaped bill. It is thought to rely largely on touch to locate its prey.

Scientific classification. Night herons belong to the heron family Ardeidae. The black-crown night heron is *Nycticorax nycticorax;* the Nankeen heron is *N. caledonicus;* the boat-bill heron is *Cochlearius cochlearius.*

Nighthawk is a bird that looks much like the whippoorwill, to which it is related. It is not a hawk. The nighthawk is about 25 centimetres long, and has mixed brown, black, and white feathers, and a white throat patch. It has a white bar on each wing. Soon after sunset the nighthawk flies high to look for insects. It breeds mainly in North America. In winter, it is found in South America. The female lays two speckled eggs on the ground or on gravel rooftops.

The nighthawk often flies in urban areas during the evening, hunting for insects that are attracted by the city lights.

Scientific classification. The nighthawk belongs to the nightjar family, Caprimulgidae. The eastern nighthawk is *Chordeiles minor.*

Nightingale is a small bird of the thrush group. Nightingales live in western and central Europe. The nightingale is famed for its beautiful, sad voice.

The nightingale has a plain appearance, and shy habits. It is about 15 centimetres long, with russet-brown upper parts and a reddish rump and tail. The breast and underparts are mostly white. The bird is most at home in undergrowths of woods and in hedges, especially along streams. It lives mainly on insects. It hops rapidly along the ground for a few moments and then stands motionless as if listening, as the robin does.

The nightingale is a small thrush known for its melancholy song. Nightingales nest in thickets or hedges near the ground.

Nightingales have only one brood of young in a season. They build their nests near the ground in thickets or hedges. The female lays from four to six olive-brown eggs. The birds migrate to Africa for the winter.

Scientific classification. The nightingale and other thrushes make up the subfamily Turdinae in the family Muscicapidae. (Some authorities consider the thrushes a separate family, Turdidae.) The nightingale is *Luscinia megarhynchos.*

See also **Bird** (picture: Birds of Europe).

Nightingale, Florence (1820-1910), was the founder of the nursing profession as we know it today. British soldiers who were wounded in the Crimean War called her "Lady with the Lamp" when she walked the halls of their hospital at night. The light that she carried has come to mean care for the sick, concern for the welfare of the ordinary soldier, and freedom for women to choose their own work. She was called a "saintly woman." But her success was also due to her ability to organize and administer the details of hospital work.

Early years. Florence Nightingale was named after Florence, Italy, where she was born on May 12, 1820, while her wealthy British parents were living abroad. Her childhood was spent on the family estates in England with her mother, father, and sister Parthenope. Mrs. Nightingale taught her daughters the social graces and how to run a large household. Their father, William, tutored them in languages, history, and philosophy.

At the age of 16, Florence thought she heard the voice of God telling her she had a special mission in life. She suspected this mission had something to do with helping other people. Florence had always enjoyed caring for the babies of her parents' visitors and for sick farmers on her father's estates.

Meanwhile, Florence was pulled reluctantly into the round of parties and other functions characteristic of her social position. She was presented to Queen Victoria at the appropriate time and also travelled in Europe.

But Florence had not forgotten her purpose in life. Slowly, she began to realize what work must be acomplished. She turned down suitors, declined many parties, and spent much of her time studying health and reforms for the poor and suffering. This was unheard-of behaviour for a wealthy girl. Mrs. Nightingale could not accept it.

Her family's opposition initially prevented Florence from working in a hospital. She took a step toward independence when she entered the Institution of Deaconesses, a Protestant school for training nurses, in Kaiserswerth, a town near Düsseldorf, Germany. She later studied in Paris. At 33, she became superintendent of a women's hospital in London.

Service in Crimea. Great Britain and France went to war with Russia in the Crimea in 1854. The British people were angry when they heard that their troops had been sent to battle without enough supplies, to die under terrible conditions. The secretary of war asked Florence Nightingale to take charge of nursing. She sailed for the Crimea with 38 nurses.

This little band, in drab grey uniforms, stepped ashore in the mud of Scutari, across from Constantinople (now Istanbul), in late 1854. They faced a job that seemed impossible. Wounded troops had just arrived from the Battle of Balaklava, where the charge of the "Light Brigade" had taken place. About 250 of the British cavalrymen had been killed or wounded there in 20 minutes. See **Balaklava, Battle of.**

The hospital was an old Turkish barracks, rat-infested, dirty, and poorly furnished. Many of the wounded lay on floors, bleeding and uncared for. There were not enough beds, mattresses, or bandages, and no washbasins, soap, or towels. Nightingale found a few men well enough to clean the place, and she put them to work at once. She set up a nursing schedule for care, kitchen work, and diets. At night, her lamp burned as she walked the 6 kilometres of corridors and as she later wrote countless reports and letters demanding supplies from British military officials.

At first, doctors and officials resented the "dictatorship of a woman," as they regarded it, for Florence Nightingale stood for no delays or slipshod ways. But they eventually came over to her side. When the hospital was running better, she started classes to teach convalescent soldiers to read and write.

While on a visit to the front lines, Nightingale caught Crimean fever, and nearly died. By that time, she had become famous, and even Queen Victoria kept an anxious watch on her recovery.

After she returned to the Scutari hospital, Nightingale was urged to go to England to get her strength back. She replied firmly that she was "ready to stand out the war with any man." Her success at Scutari became so widely recognized that she was given charge of all the army hospitals in the Crimea. By the end of the war, she had saved many lives and brought about worldwide reforms in hospital administration and nursing.

Return to England. England greeted her arrival in 1856 with big celebrations. Instead of attending them, Nightingale went quietly home to her family, and then moved to London. The strain of overwork and her Crimean illness had injured her health. Nightingale became a semi-invalid and seldom left her rooms. Instead, the world came to her.

Ministers, heads of government, authors, reformers, and politicians came to ask her advice. Nightingale's report of over 1,000 pages to the British War Department brought about the formation of the Royal Commission on the Health of the Army in 1857. By correspondence and constant reading, she made studies of health conditions in India. Another Royal Commission was appointed in 1859, resulting in the establishment of a Sanitary Department in India in 1868.

In 1860, Nightingale used a gift of money from her grateful public to found the Nightingale Training School for Nurses at St. Thomas's Hospital in London. She became a world authority on scientific care of the sick. The United States asked her advice on setting up military hospitals during the American Civil War (1861-1865).

Florence Nightingale, *above,* introduced sanitary methods of nursing in wartime. In a hospital in Scutari, she attended to the needs of British soldiers wounded in the Crimean War, *left.*

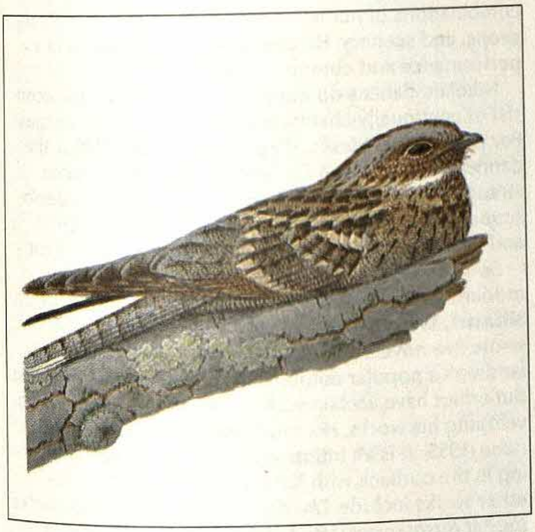
Nightingale received many public honours, and was the first woman to be awarded the British Order of Merit.

Nightjar is the name of about 70 species of birds that fly at night or dusk. They get their name from their nocturnal habit and from the jarring-churring call of the common *European nightjar.* Most other nightjars have similar strange-sounding calls. For example, the Australian *long-tailed nightjar* is called axebird or carpenterbird from the *chop-chop* notes it produces.

Nightjars have a small bill but can open it very wide for catching insects in flight. When they fly, nightjars look like giant moths. With their long wings and tail feathers fanned out they are fast and graceful fliers.

During the day, many species of nightjar rest on the ground. Their dull colouring, grey and brown mottled with white, acts as an effective camouflage. Nightjars nest on the ground. Young nightjars lie motionless like their parents, to protect them against predators such as hawks and foxes.

Most species of nightjar live in tropical or subtropical areas. Many species have wing or tail ornaments that are used in courtship displays and break off or are moulted after the breeding season. The *standard-winged nightjar* of Africa has two long trailing standards on its forewings. The north American *poorwill* is the only bird known to hibernate. During cold weather it rests in the shelter of a rock crevice.



The nightjar has grey, brown, and white colouring that serves as effective camouflage. The bird is most active at night.

Scientific classification. Nightjars belong to the family Caprimulgidae. The European nightjar is *Caprimulgus europaeus;* the long-tailed nightjar is *C. macrurus;* the standard-winged nightjar is *Semiophorus longipennis;* and the poorwill is *Phalaenoptilus nuttallii.*

Nightmare is a frightening dream or dreamlike experience that wakes a sleeper. After waking from most nightmares, the sleeper can recall the dream that caused the fright. Another kind of frightening sleep event, called a *night terror,* occurs without a true dream. The sleeper wakes terrified early in the night, often with a feeling of pressure on the chest. Night terrors occur during the first hours of sleep. True nightmares occur later, during *dreaming sleep* (see **Sleep** [What happens during sleep]).

Nightmares may occur in times of severe tension. They have been experienced by many soldiers in combat and by people withdrawing from alcohol or certain other drugs. All children between the ages of 2 and 6 probably have some nightmares. Some nightmares seem entirely real to a youngster after waking. Most adults do not have nightmares. Frequent nightmares among older children or adults may indicate a physical or emotional problem.

See also **Dream.**

Nightshade is the common name of the family of plants that have the scientific name Solanaceae. There are nearly 3,000 species throughout the world. The plants grow especially in Central and South America.

Various species in the nightshade family are grown for food. These include the potato, tomato, aubergine, capsicum (red, chili, and bell peppers), and such tropical species as naranjilla and tree tomatoes. The family also includes a number of poisonous and medicinal plants, such as henbane, thorn apple, and deadly nightshade. Several species are a commercial source of such *alkaloids* as atropine, hyoscyamine, nicotine, and scopolamine (see **Alkaloid**). Other species are an important source of food for many wild animals. The petunia flower and the tobacco plant also belong to the nightshade family.

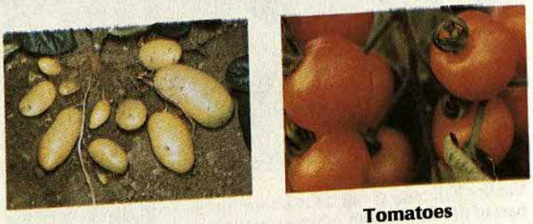
Superstitions and folklore surround many plants in the nightshade family. Europeans once associated some species with witchcraft. In the 1500's, many people believed tomatoes and potatoes were poisonous.

Related articles in ***World Book*** include:

Apple of Sodom
Aubergine
Bittersweet
Capsicum
Deadly nightshade
Henbane
Petunia
Potato
Solanum
Thorn apple
Tobacco
Tomato

Some members of the nightshade family

Deadly nightshade **Thorn apple**



Potatoes **Tomatoes**

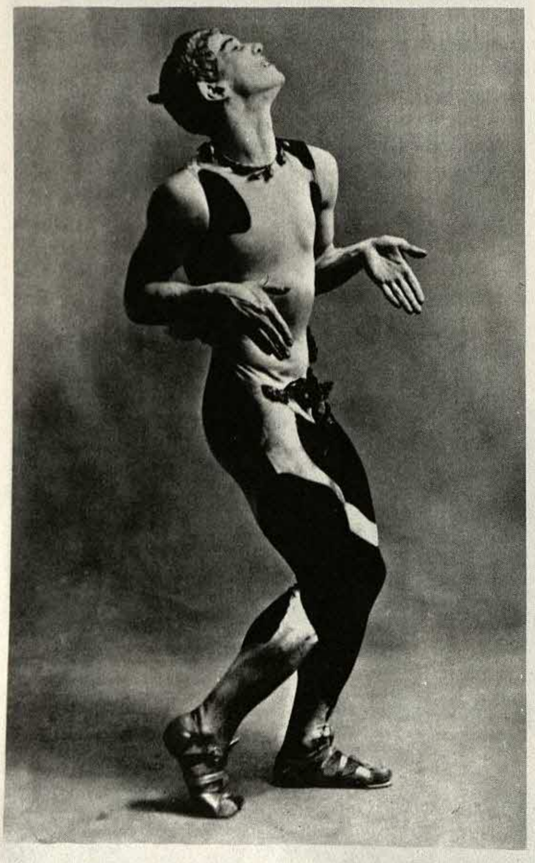
Nihilism is the name used for a variety of extreme, negative philosophical and political views. The term *nihilism* comes from a Latin word meaning *nothing.* The most radical nihilist would deny that anything exists. A slightly less radical view, which is usually called *scepticism,* denies that anything can be known.

Nihilism is most commonly understood as the view that no absolute values exist. The Russian author Fyodor Dostoevsky challenged this view in his novel *The Brothers Karamazov.* He wrote that if no God exists, then everything is permitted. He argued that belief in God is necessary for believing in any absolute values.

The term *nihilist* first came into popular use during the mid-1800's in Russia. It applied to radical opponents of the czar, some of whom committed terrorist acts against the government. Used more broadly, *nihilism* referred to any extreme challenge to authority. Ivan Turgenev portrayed a nihilist in his novel *Father and Sons.* This character believes in reason and a scientific conception of the world, but he rejects traditional religious beliefs and moral values.

See also **Nietzsche, Friedrich; Turgenev, Ivan.**

Nijinsky, Vaslav (1890?-1950), was the most famous male dancer of his time. He was short, with thick thighs and sloping shoulders. Yet he acted out his roles so completely that his appearance seemed to change from one role to another.



Vaslav Nijinsky created the choreography and also danced the part of the faun in *The Afternoon of a Faun* in 1912.

Nijinsky had such amazing body control that his dancing looked spontaneous and effortless. One legend tells of a dramatic leap he made through an open window as his exit in *Le Spectre de la Rose.* He rose slowly, soared across the window ledge, appeared to stop in midair, and was still at the height of his jump as he disappeared.

Nijinsky was born in Kiev, Ukraine (then part of the Russian Empire). He first studied dancing at the St. Petersburg Imperial School of Ballet at the age of 10. He travelled with Sergei Diaghilev's ballet company to Paris in 1909, and enjoyed great international success until 1913. He married a dancer in the company in 1913, and Diaghilev dismissed him. Nijinsky rejoined the company in the United States in 1916, dancing as brilliantly as ever. But in 1917, mental illness ended his career.

See also **Ballet** (Russian ballet; picture: Vaslav Nijinsky and Anna Pavlova).

Nike, Temple of. See **Acropolis.**

Nike of Samothrace. See **Winged Victory.**

Nikolais, Alwin (1912-1993), was an American *choreographer* (composer of dances). His works are clever combinations of human movement, costumes, lighting, props, and scenery. He designed such elements of a performance and composed the music.

Nikolais' dances do not tell a story. Instead, they consist of continually changing and unusual visual images. For example, in *Masks, Props, and Mobiles* (1953), the dancers are enveloped by elastic bags and become strange, humanlike shapes. His works include *Kaleidoscope* (1956), *Totem* (1960), *Imago* (1963), *Triad* (1976), and *Crucible* (1985). Nikolais was born in Connecticut.

See also **Dancing** (picture: A performance of the modern dance *Imago*).

Niland, D'arcy (1917-1967), an Australian author, wrote five novels and more than 500 short stories. Niland was a popular author rather than a literary novelist. But critics have acclaimed him for his expert craft in developing his works. His most popular novel is *The Shiralee* (1955). It is an intimate portrayal of a man wandering in the outback with his 4-year-old daughter. His other works include *The Big Smoke* (1959) and *Ballad of the Fat Bushranger* (1961). D'arcy Francis Niland was born in Glen Innes, New South Wales.

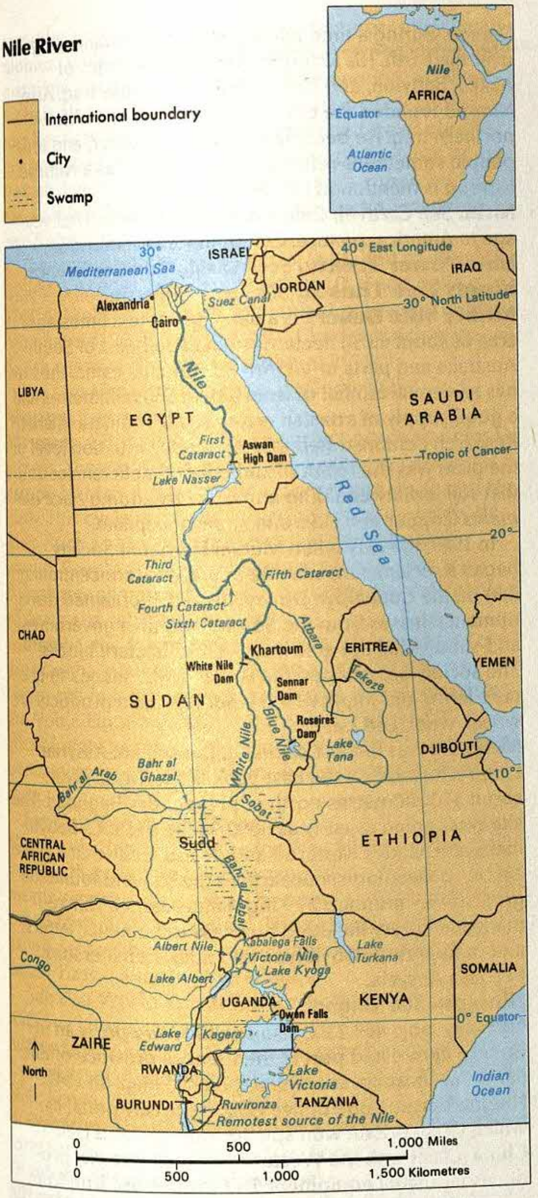
Nile, Battle of the. See **Nelson, Horatio** (Battle of the Nile).

Nile monitor. See **Lizard** (picture).

Nile River is the longest river in the world. It flows for 6,671 kilometres through northeast Africa. The Nile rises near the equator and flows into the Mediterranean Sea. The Nile irrigates about 2.4 million hectares of land in Egypt and about 1.1 million hectares in Sudan.

The Nile Valley and the Nile Delta rank among the world's most fertile farming areas. Until 1968, water from the Nile deposited fertile *silt* (particles of soil) in the valley and on the delta, where the Nile flows into the Mediterranean. In 1968, the Aswan High Dam at Aswan, Egypt, began operating. This dam ended the annual floods and trapped the Nile's silt in Lake Nasser.

The course of the Nile. The Nile flows generally northward throughout its course. Its southernmost source is the Ruvironza River in Burundi. Lake Victoria ranks as the Nile's largest source. The Nile flows through the Sudd, a vast swamp in southern Sudan, where about half of the water evaporates.

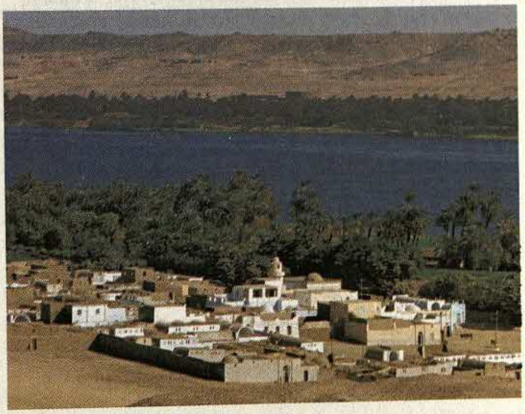

Nile River

The Nile is called the White Nile between the Sudd and Khartoum, Sudan. At Khartoum, the Blue Nile from Ethiopia joins the White Nile. North of Khartoum, the river is called simply the Nile. The Atbara River, which is another chief source of the Nile, drains into it in Sudan, about 280 kilometres north of Khartoum.

About 70 per cent of the Nile's water comes from the Blue Nile. The flow of water in the Blue Nile and the Atbara varies greatly. Flooding by these rivers caused the annual floods of the Nile in Egypt.

North of Cairo, Egypt, the Nile divides into separate channels in the Nile Delta. The delta has some swampy land and salty lakes, as well as highly fertile soil.

The Nile Valley and Nile Delta make up a total of about 3 per cent of Egypt's area. Almost all Egyptian farms lie in this densely populated region. Water from the Nile enables farmers in the valley and delta to raise


The Nile irrigates large strips of farmland. The Egyptian farm village shown above lies north of the Aswan High Dam.

The Blue Nile, one of the two main branches of the Nile, has carved out a deep valley in Ethiopia, *above.*

Murchison Falls, *above,* is on the Victoria Nile in western Uganda, about 32 kilometres east of Lake Albert.

various crops all year round. The chief winter crops, in order of area planted, include clover, wheat, and beans and other vegetables. The main summer crops are cotton, maize, rice, and millet. Cotton is Egypt's most important crop financially.

See also **Aswan High Dam; Delta; Egypt** (The land; picture); **Lake Nasser.**

Nilgai. See **Antelope** (Kinds of antelope).

Nilotes. See **Africa** (People).

Nilsson, Birgit (1918-), is a celebrated Swedish dramatic soprano. She became noted for the power and clarity of her voice. Critics generally regard Nilsson as one of the finest singers of heroic roles in the operas of Richard Wagner. Her performances as the Wagnerian heroines Isolde and Brünnhilde set the standard for her time. Nilsson also achieved fame in the roles of Aida, Lady Macbeth, Salome, and Tosca. However, many critics rate her performance in the title role of Giacomo Puccini's *Turandot* as her outstanding achievement.

Nilsson was born in Vastra Karup, near Malmö. She made her opera debut in 1946 as Agathe in Carl Maria von Weber's *Der Freischütz* at the Royal Opera of Stockholm. She first appeared at the Metropolitan Opera in New York City in 1959 as Isolde. Nilsson's recordings are considered masterpieces of dramatic soprano singing.

Nimbus. See **Cloud.**

Nimbus scientific satellite. See **Space travel** (picture: The Nimbus scientific satellite).

Nimitz, Chester William (1885-1966), served as commander in chief of the United States Pacific Fleet during World War II (1939-1945). He took command on Dec. 31, 1941, about three weeks after the fleet had been almost completely disabled in the Japanese attack on Pearl Harbor.

Admiral Nimitz painstakingly rebuilt U.S. strength in the Pacific. As commander of the Pacific Fleet and the Pacific Ocean Areas, he directed the U.S. Navy and the Marine Corps forces. His calm assurance of final victory helped restore the U.S. Navy's faith in its power and ability.

In the early months of the war, Admiral Nimitz refused to attack before U.S. forces were fully ready, in spite of angry questions from Congress and newspapers. He waited until he had enough ships, supplies, and troops to assure victory. Nimitz developed much of the strategy of *island hopping* (seizing only key islands from which attacks on other key islands could be launched). This strategy saved lives and time. Nimitz led the fleet through many victories until it drove the Japanese back to Japan. He was promoted to fleet admiral in 1944. Nimitz signed for the United States at the Japanese surrender ceremonies in Tokyo Bay in 1945.

After the war, Nimitz became chief of naval operations. He left active duty in 1947, and then became special assistant to the secretary of the U.S. Navy. Nimitz headed the United Nations commission that mediated the dispute over Kashmir in 1949. Nimitz was born in Fredericksburg, Texas, and graduated from the U.S. Naval Academy in 1905.

See also **World War II** (The war in Asia and the Pacific).

Nimrod, in the Old Testament, was a mighty ruler and builder of cities. He was a grandson of Ham, one of Noah's sons. Nimrod lived hundreds of years after the Deluge, during a time when people were wandering over the earth. His kingdom included the cities of Akkad, Babylon, and Uruk, all in present-day Iraq. Also, Nimrod founded the city of Nineveh, in what is now northern Iraq. He became famous as a hunter, and today people sometimes refer to a skilful hunter as a Nimrod. Nimrod is mentioned in Genesis 10: 8-10.

Niña. See **Caravel; Columbus, Christopher** (First voyage to America; picture: Columbus' three ships).

Nine-Power Treaty. See **Washington Conference.**

Ninety-Five Theses. See **Luther, Martin.**

Ninety Mile Desert is a name given to a limestone area of about 4,050 hectares in the southeast of South Australia and parts of Victoria. Despite its name, the area has an annual rainfall of from 430 to 560 millimetres and a good supply of artesian water in the Tintinara district. Research demonstrated that the low production level of the plain was the result of soil mineral deficiencies and that soil fertility could be improved by adding *trace elements* (copper and zinc) and superphosphate.

In 1949, the Australian Mutual Provident Society began a reclamation scheme in the area, concentrating first on the Coonalpyn Downs district. It obtained developmental leases from the South Australian government and subdivided the area into 405 810-hectare blocks. The society has assisted the settlers with finance to procure farms and improve the land. The main products are wheat, wool, and beef.

Nineveh was the last capital of the ancient Assyrian Empire. It stood on the east bank of the Tigris River, about 370 kilometres north of present-day Baghdad. The site was settled as early as 5000 B.C. In 612 B.C., Babylonians and Medes captured and destroyed the city. In the 1800's, archaeologists unearthed the site and found the great library founded by King Ashurbanipal. This remarkable library included business documents, letters, and examples of Babylonian and Sumerian literature. See also **Assyria.**

Ning-po. See **Ningbo.**

Ningbo (pop. 468,230), also spelled *Ning-po,* is an industrial centre and port in the Chinese province of Zhejiang. For location, see **China** (political map). In 1842, Ningbo became one of five Chinese "treaty ports" in which Great Britain won special trading rights (see **China** [Clash with the Western powers]). The city produces industrial equipment. Its factories use iron from nearby mines.

Niobe was a queen in Greek mythology who was famous for eternally mourning her dead children. Niobe was the daughter of King Tantalus and Queen Dione, and married Amphion, king of Thebes. She boasted that because of her six (or seven) fine sons and six (or seven) beautiful daughters, she deserved worship more than the goddess Leto, who had only two children, Apollo and Artemis. In anger, Leto ordered Apollo and Artemis to kill Niobe's children with their arrows. Niobe was heartbroken and wept unceasingly for her children. The gods in pity changed her into a rock that spouted water like tears. According to tradition, this rock with a waterfall below stands on Mount Sipylon in what is now Turkey.

Niobium, also called *columbium,* has the chemical symbol Nb. It is a soft, silver-white or grey metallic element. In nature, it occurs chiefly combined with *tantalum,* another rare metal. Manufacturers alloy much niobium with nickel and steel to make strong structural materials that are resistant to high temperatures. Niobium is also used in the cores of certain nuclear reactors because it allows neutrons to penetrate easily and can withstand high-temperature reactor coolants. At extremely low temperatures, it becomes a *superconductor,* so it is used in making superconducting magnets (see **Superconductivity**).

The atomic number of Niobium is 41, and its atomic weight is 92.9064. It melts at 2468 ± 10° C and boils at 4742° C. Niobium has a density of 8.57 grams per cubic centimetre at 20° C (see **Density**). Charles Hatchett, a British chemist, discovered niobium in 1801.

See also **Element, Chemical** (Periodic table).

Nippon. See **Japan.**

Nirvana, a Buddhist belief, is perfect peace and blessedness. The attainment of nirvana enables a person to escape from a painful, continuous cycle of death and rebirth. This cycle is caused by an individual's worldly desires, such as a craving for fame, immortality, and wealth. People attain nirvana when such desires are completely eliminated. Then, when they die, their cycle of death and rebirth ends.

Buddha, the founder of Buddhism, preached that nirvana can be attained by following a Middle Way between self-indulgence and self-denial, and by practising the Noble Eightfold Path. The Noble Eightfold Path consists of eight aspects of correct living, including proper behaviour, proper meditation, and proper insight into truth.

See also **Buddhism** (Dharma).

Nisei is the Japanese name for the children of Japanese families that migrate to other countries. The word *Nisei* means *second generation.* The people who migrate are called *Issei* (first generation). The children of Nisei are called *Sansei* (third generation), and their children are called *Yonsei* (fourth generation).

See also **World War II** (On the home front).

Nit. See **Louse.**

Nithsdale (pop. 56,616) is a local government district in Dumfries and Galloway Region, in the valley of the River Nith, Scotland. It is administered from the ancient town of Dumfries. The district is mainly agricultural, has some forest areas, and attracts tourists. Some industry is at Dumfries, Sanquar, and Kirkconnel.

Nitrate is any kind of compound that contains the inorganic nitrate ion (NO_3^-). Hydrogen nitrate (HNO_3) is more commonly known as *nitric acid.* Almost all metals form nitrate salts when combined with nitric acid. Two important nitrate salts, potassium nitrate (KNO_3) and ammonium nitrate (NH_4NO_3), are used as fertilizers to replenish nitrogen in the soil. Certain bacteria in the soil form nitrates from organic compounds that contain nitrogen. Plants use these nitrates to make proteins. Nitrates are also important in the manufacture of explosives, fireworks, heart medicine, and photographic films. People take in nitrates daily, primarily from vegetable sources. However, consuming large amounts of nitrates can lead to the production of toxic substances in the body.

See also **Nitric acid; Nitrogen cycle.**

Nitrate of silver. See **Silver nitrate.**

Nitre. See **Saltpetre.**

Nitric acid is a strong inorganic acid with the chemical formula HNO_3. It has many industrial uses. Its principal use is for the production of fertilizers and explosives. Large quantities of nitric acid are produced during thunderstorms and fall to the earth in rain. The rain falls as a very weak solution of nitric acid. The production of nitric acid during thunderstorms allows nitrogen from the air to become part of the soil in a form that plants can use (see **Nitrogen cycle**). Nitric acid was one of the first acids known. Many alchemists of the Middle Ages used it in their experiments.

Nitric acid is such a powerful oxidizing agent that it dissolves many metals. But it does not attack gold and platinum. A drop of nitric acid on a piece of jewellery tells whether it is made of genuine gold or platinum. These two metals can be dissolved by *aqua regia,* a mixture of nitric acid and hydrochloric acid (see **Aqua regia**).

Nitric acid is used to manufacture ammonium nitrate, NH_4NO_3, an ingredient of many fertilizers, and to make explosives, flares, and rocket propellants. The chemical industry uses nitric acid to prepare nylon and many organic compounds that are used as dyes and medicines. Nitric acid reacts with toluene in the presence of sulphuric acid to form trinitrotoluene, better known as TNT.

Commercially, most nitric acid is produced by oxidizing ammonia using a platinum catalyst. Ammonia and air are passed through heated platinum gauze. The gases react to form water, nitrogen monoxide (NO), and nitrogen dioxide (NO_2). Upon cooling, this gaseous mixture forms nitric acid. This method is called the *Ostwald process,* after Wilhelm Ostwald, the German chemist who developed it. Nitric acid is also produced by heating saltpetre with sulphuric acid. In this process, nitric acid is recovered by distillation.

Nitric acid is a colourless liquid with a suffocating odour. It develops a yellow colour if kept in bottles that are not tightly stoppered. This is due to nitrogen dioxide gas that results from decomposition of the acid. Nitric acid can cause painful burns. The metal salts of nitric acid, called *nitrates,* are soluble in water.

Nitric oxide. See **Nitrogen** (Nitrogen and pollution).

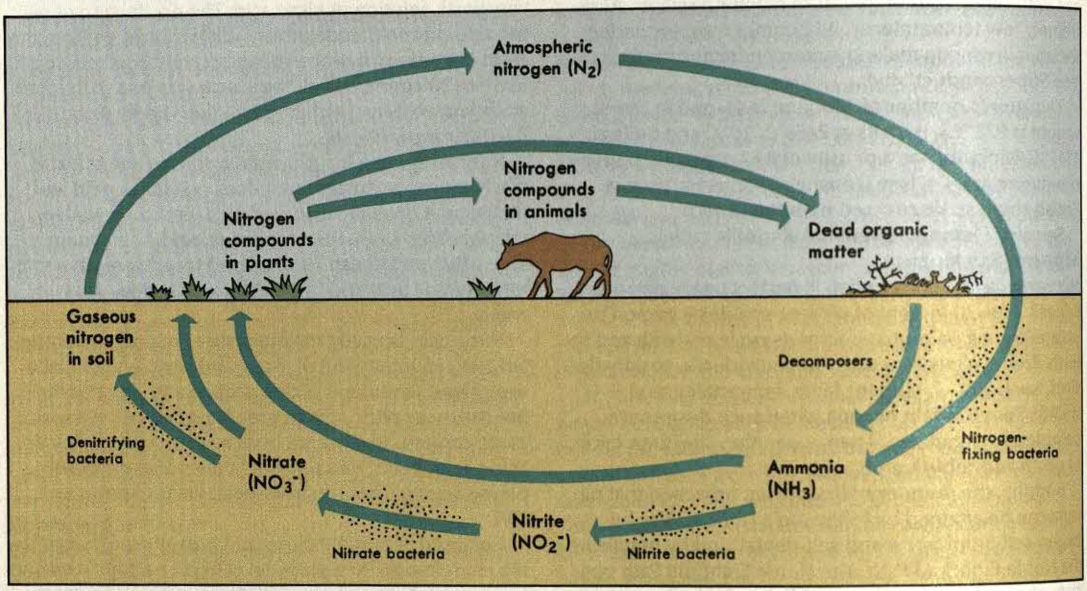
Nitrifying bacteria. See **Nitrogen cycle.**

Nitrite is a compound of the nitrite *anion* (NO_2^-) and some other element. An anion is a negatively charged ion. Inorganic nitrites are stable and soluble. Most organic nitrites are made from alcohols. They are unstable when in the presence of acid, but they are preserved satisfactorily in neutral or mildly alkaline solutions. Nitrites are used in medicine for heart ailments. Sodium nitrite is important in making dyes. It is also used to cure meats, such as bacon, to prevent botulism and to give the meat a pinkish colour. Under certain conditions, sodium nitrite may combine with other chemicals to form nitrosamines, which can cause cancer. Most countries limit the amount of sodium nitrite allowed in cured meats. Nitrites are also used in photography and in the manufacture of organic materials.

Nitrocellulose. See **Guncotton.**

Nitrogen is a chemical element that occurs in nature mainly as a gas. Its symbol is N. Nitrogen makes up about 78 per cent of the air by volume. Daniel Rutherford, a Scottish doctor, discovered nitrogen in 1772.

The nitrogen cycle Nitrogen makes up about 78 per cent of the earth's atmosphere, but most organisms cannot use nitrogen in its gaseous form. *Nitrogen-fixing bacteria* convert atmospheric nitrogen into a form that other living things can use. After nitrogen has been fixed by the bacteria, it circulates repeatedly between organisms and the soil. *Denitrifying bacteria* help to regulate the amount of nitrogen in biological circulation by changing some fixed nitrogen back into a gas.



Nitrogen belongs to the group of elements called *nonmetals.* Its atomic number is 7, and its atomic weight is 14.0067. Nitrogen gas is colourless, odourless, and tasteless. It is only slightly soluble in water, and it does not combine easily with most other elements. Nitrogen may be condensed to a liquid that boils at −195.8° C and freezes at −209.9° C.

Nitrogen and life

All organisms must have nitrogen to live. It makes up an important part of protein molecules, which are found in protoplasm. Protoplasm is the living material in all plant and animal tissues. Human beings and animals get protein by eating other animals and plants.

Most plants must manufacture their protein from simple nitrogen compounds dissolved in the soil. Some of this dissolved nitrogen comes from the atmosphere in the form of *nitric acid* (HNO_3). Lightning causes the nitrogen and oxygen in the air to form compounds called *nitrogen oxides.* These oxides react with water to form nitric acid, which is carried to the earth dissolved in rain water.

Plants of the *legume* family produce protein from the nitrogen of the air, with the help of certain types of bacteria. Legumes include such plants as alfalfa, peas, and soybeans. The roots of these plants have small swellings called *nodules.* The nodules contain *nitrogen-fixing bacteria,* which take nitrogen from the air and convert it into nitrogen compounds. The plants use these compounds to make protein. After the plants die and decay, the nitrogen compounds become part of the soil.

As nitrogen is used and reused by living things, it goes through a continuous cycle of chemical changes. This cycle of changes is known as the *nitrogen cycle* (see **Nitrogen cycle**).

Uses of nitrogen

Manufacturers make pure nitrogen by distilling liquid air (see **Liquid air**). Air consists almost entirely of nitrogen and oxygen. During the distillation process, the nitrogen boils before the oxygen does, because nitrogen has a lower boiling point. As it vaporizes, the nitrogen is collected and stored under pressure in steel cylinders.

Production of ammonia. The principal use of nitrogen is in the production of ammonia (NH_3), a gas that consists of nitrogen and hydrogen. Manufacturers produce ammonia chiefly by the *Haber process.* In this process, nitrogen and hydrogen are combined at about 550° C and at 200 to 250 times normal atmospheric pressure. The reaction takes place in the presence of a *catalyst,* a substance that increases the rate of a chemical reaction.

Ammonia is used as a fertilizer and in the production of explosives, nitric acid, and other chemicals. A common household cleaning agent consists of a dilute solution of ammonia in water.

Nitrogen in agriculture. Almost all fertilizers used by farmers and gardeners contain nitrogen, which promotes the healthy growth of plants. Ammonia is the most common nitrogen fertilizer. Farmers inject ammonia gas directly into the soil, where it dissolves and helps plants to grow. Liquefied ammonia and such compounds as ammonium sulphate and ammonium nitrate are also used as nitrogen fertilizers. Other sources of nitrogen include manure and *guano,* the waste material of sea birds. See **Fertilizer.**

Farmers can also supply nitrogen to their fields by rotating certain crops. In crop rotation, a farmer plants a field one year with maize, wheat, or some other crop that removes nitrogen from the soil. The next year, the farmer plants the same field with a crop of legumes—such as alfalfa or soybeans—that restores nitrogen to the soil.

Uses of liquid nitrogen. The food industry uses liquid nitrogen to quick-freeze food (see **Food, Frozen** [Nitrogen freezing]). Liquid nitrogen also serves as a refrigerant for food during transport. Scientists use liquid nitrogen to produce the low temperatures necessary in some experiments.

Nitrogen and pollution

People influence the nitrogen cycle. The use of nitrogen fertilizers adds nitrogen to the soil. Rain water carries unused fertilizer and other nitrogen compounds into streams and lakes, where the compounds cause water plants and algae to multiply. As the plants and algae die and decay, they use up oxygen, endangering animal life in the body of water.

Nitrogen oxides pollute the air. These pollutants are released by the burning of fossil fuels, such as coal and petrol. Sunlight causes nitrogen oxides in the atmosphere to react with oxygen to form ozone, an irritating substance in *smog.* Nitrogen oxides can also return to earth as nitric acid, a major ingredient of *acid rain.*

Jet engines produce nitrogen oxides in the upper atmosphere, where the compound may harm the environment in a different way. Nitrogen oxides can promote the decomposition of ozone in the upper atmosphere. Here, ozone benefits animals and plants by shielding them from harmful ultraviolet light.

Related articles in ***World Book*** include:

Borazon
Environmental pollution
Nitrate
Nitric acid
Nitrite
Nitroglycerin
Nitrous oxide
Saltpetre

Nitrogen cycle is the circulation of nitrogen among the atmosphere, soil, water, and plants and animals of the earth. All living things require nitrogen, but most organisms cannot use the gaseous nitrogen (N_2) that makes up about 78 per cent of the air. They must have nitrogen that has combined with other elements to form compounds. However, the supply of this *fixed nitrogen* is limited. Therefore, complex methods of recycling nitrogen have developed in nature.

After plants and animals die, they undergo decomposition by certain bacteria and fungi. These microorganisms produce ammonia (NH_3) from nitrogen compounds in dead organic matter and in body wastes excreted by animals. Plants absorb some of the ammonia and use it to make proteins and other substances essential to life.

Ammonia that is not absorbed by plants is changed into nitrates (NO_3^- compounds) by *nitrifying bacteria.* There are two types of nitrifying bacteria—*nitrite bacteria,* which convert ammonia into nitrites (NO_2^- compounds); and *nitrate bacteria,* which change nitrites into nitrates. Plants absorb most of the nitrates and use them in the same way as ammonia. Animals get nitrogen by eating plants or by feeding on other animals that have eaten plants.

A process called *nitrogen fixation* constantly puts additional nitrogen into biological circulation. *Nitrogen-fixing* bacteria and algae take nitrogen from the air and convert it into ammonia. Much of this ammonia is absorbed by plants, but some of it is lost in the atmosphere.

Although nitrogen fixation removes nitrogen from the atmosphere, a reverse process called *denitrification* returns an approximately equal amount of nitrogen to the air. *Denitrifying bacteria* convert some of the nitrates in soil back into gaseous nitrogen or nitrous oxide (N_2O). However, fixed nitrogen may circulate many times between organisms and the soil before denitrification returns it to the atmosphere.

Some human activities interfere with the nitrogen cycle. For example, industry fixes vast quantities of nitrogen to produce fertilizer. The fertilizer provides great benefits, but excess amounts are washed off farmland and into waterways, polluting the water. In addition, the combustion of petrol and some other fuels produces nitrogen compounds that contribute to air pollution.

See also **Nitrogen; Legume; Nitrate; Nitrite.**

Nitroglycerin, also called nitroglycerol, is a powerful explosive. Its chemical formula is $C_3H_5(ONO_2)_3$. It is the principal explosive ingredient of dynamite. Pure nitroglycerin is a heavy, oily liquid that is as clear as water. But the commercial product is usually straw-coloured. When nitroglycerin explodes, it expands to form gases that take up more than 3,000 times as much space as the liquid. The explosion of nitroglycerin is about three times as powerful as that of an equal amount of gunpowder, and the explosion speed is 25 times as fast as that of gunpowder.

Chemists make nitroglycerin by slowly adding glycerol, also known as glycerin, to concentrated nitric and sulphuric acids. The nitroglycerin forms a layer on top of the two acids. This layer is drawn off and washed, first with water, then with a solution of sodium carbonate.

Ascanio Sobrero, an Italian chemist, discovered nitroglycerin in 1846. For many years, it was not used widely because it was unreliable. In 1864, Alfred Nobel, a Swedish chemist, obtained a patent on a detonating cap made of mercury fulminate, which proved ideal for exploding nitroglycerin. In 1867, Nobel invented dynamite, which provided a safe and convenient means for the transportation and use of nitroglycerin. Nitroglycerin quickly became the most widely used explosive.

Nitroglycerin is an ingredient of many smokeless powders, such as cordite and ballistite. It is seldom used alone as an explosive, except for blasting in oil wells. Doctors use nitroglycerin to treat certain heart and circulatory diseases.

See also **Dynamite; Explosive; Glycerol; Heart** (Treating coronary artery disease).

Nitrous oxide is a colourless, odourless gas that doctors and dentists use to make patients insensitive to pain. Such drugs are called anaesthetics. Nitrous oxide is commonly called *laughing gas* because people sometimes become excited and silly after they inhale it. Nitrous oxide causes unconsciousness if enough of it is inhaled. Nitrous oxide is pleasant to inhale and it takes effect quickly. It also wears off rapidly and is nonflammable. Doctors always give oxygen with nitrous oxide because the body cannot use the oxygen in nitrous oxide molecules.

Nitrous oxide is a weak anaesthetic and high concentrations must be used to produce full anaesthesia for surgery. However, lower concentrations can relieve pain without producing true anaesthesia and loss of consciousness.

Nitrous oxide was first prepared in 1772 by Joseph Priestley, a British chemist. In 1844, Horace Wells, an American dentist, was the first to use nitrous oxide. He inhaled the gas himself before having a tooth extracted. Nitrous oxide anaesthesia became widely used in dentistry during the 1860's.

Nitrous oxide is also called *nitrogen monoxide* or *dinitrogen monoxide.* Its chemical formula is N_2O. It is used as a propellant in aerosol products and as a "tracer gas" to locate leaks in vacuum and pressure lines.

See also **Aerosol; Davy, Sir Humphry; Priestley, Joseph.**

Niue is a self-governing island country in the South Pacific Ocean. It is about 480 kilometres northeast of Tonga and about 560 kilometres southeast of Western Samoa. See **Pacific Islands** (map). Niue is 21 kilometres long and 18 kilometres wide.

Niue has about 2,500 people. Its inhabitants are New Zealand citizens. The Niuean language is related to Tongan. The people also speak English. The Niuean people are noted for weaving fine baskets and mats from the leaves of pandanus trees. Niue has about 5,400 hectares of forest, which supplies the government timber mill. The main exports are copra, limes, and passionfruit. Pigs and poultry are reared.

Niue has a Legislative Assembly of 20 members, 14 being elected by village constituencies and 6 from a common roll. There is a cabinet made up of a premier and three ministers.

It is believed that Polynesian people have lived on Niue for more than a thousand years. The Niuean language shows that some settlers came from Tonga and others from Samoa and eastern Polynesia.

The first European explorer to reach the island was James Cook. He arrived on June 20, 1774. The islanders gave Cook and his crew a hostile reception, and he named the island *Savage Island.* A British protectorate over Niue was declared in 1900, and the following year the island was annexed to New Zealand as part of the Cook Islands. The island was placed under separate administration in 1904. Niue was granted self-government by the New Zealand government in 1974, with New Zealand continuing to be responsible for defence and foreign affairs and for providing economic aid.

Nix was the name of a water sprite in German folklore. The nixes were little people with golden hair and green teeth, and they lived in lakes and rivers. Nixes were fond of music and dancing, and sometimes invited humans to their feasts. They were said to appear before anyone died of drowning.

Nixon, Richard (1913-1994), was president of the United States from 1969 to 1974. He was the only U.S. president ever to resign from office. He left the presidency on Aug. 9, 1974, while facing impeachment for his involvement in the Watergate political scandal (see **Watergate**).

Richard Milhous Nixon was born on Jan. 9, 1913, in Yorba Linda, California, U.S.A. He graduated from Whittier College, California, in 1934 and Duke University School of Law in Durham, North Carolina, in 1937. He then became a partner in a Whittier law firm. In 1942, during World War II, Nixon was called to service in the navy. He served in the Pacific until the war ended in 1945. He was promoted to lieutenant commander.

Nixon entered politics in 1946 when he won a seat in the U.S. House of Representatives after an aggressive campaign that established his reputation as an outspoken anti-Communist. A Republican, Nixon was reelected to the House in 1948 and elected to the U.S. Senate in 1950. He was vice president (1953-1961) to President Dwight D. Eisenhower.

First administration (1969-1973). Nixon's major goal was settlement of the Vietnam War. In 1969, he began a gradual withdrawal of U.S. combat troops from Vietnam. This policy became known as *Vietnamization.*

Nixon eased the tension that had existed for years between the U.S. and both China and the Soviet Union. In 1972, he became the first U.S. president to visit China while in office. He also visited the Soviet Union in 1972, and he won congressional approval of U.S.-Soviet agreements to limit the production of nuclear weapons.

Second administration (1973-1974). The Watergate scandal hit the Nixon administration during 1973. It arose from a burglary of the Democratic national headquarters in the Watergate building complex in Washington, D.C., and other illegal activities by employees of Nixon's 1972 reelection committee. Nixon's attempts to cover up these crimes became a major part of the scandal and led to a move for his impeachment.

Vice president Agnew resigned on Oct. 10, 1973, while under investigation for graft unrelated to the Watergate scandal. Gerald Ford became vice president on Dec. 3, 1973.

Impeachment hearings began before the House Judiciary Committee in October 1973. Nixon ignored *subpoenas* (legal requests) that he turn over his secret tape recordings of conversations in his White House offices. Nixon finally released records of his tapes on August 5, 1974. The taped conversations showed that Nixon approved a cover-up six days after the Watergate burglary. As a result of this evidence, he faced almost certain impeachment by the House of Representatives and removal from office by the Senate. On August 9, Nixon resigned. Ford was sworn in as president. On September 8, Ford granted Nixon a pardon for all federal crimes that Nixon may have committed while serving as president.

Nixon published his memoirs in 1978 and wrote several books on political and foreign policy issues during the 1980's.

Nizhniy Novgorod (pop. 1,443,000) is an industrial centre in Russia. It lies at the fork of the Volga and Oka rivers (see **Russia** [political map]). Nizhniy Novgorod is one of the oldest cities in Russia and is known as the *Cradle of the Russian Empire.* The city's upper part contains a fortress and historic cathedrals. The lower town is the industrial section. One of Russia's largest car factories is in Nizhniy Novgorod. Other products include aeroplanes, chemicals, locomotives, and machine tools.

Nizhniy Novgorod was an important commercial centre in the Middle Ages, when west-east travel along the Oka River and through a low pass in the Ural Mountains met north-south travel on the Volga River. In 1932, when Russia was a republic of the Soviet Union, the city was renamed Gorki in honour of the Russian writer, Maxim Gorki. The city was renamed Nizhniy Novgorod in 1990, about a year before the Soviet republics became independent.

Nkrumah, Kwame (1909-1972), was president of the West African republic of Ghana from 1960 to 1966. Army leaders ousted him in 1966, and he went into exile in nearby Guinea. President Sékou Touré of Guinea made Nkrumah Guinea's honorary president.

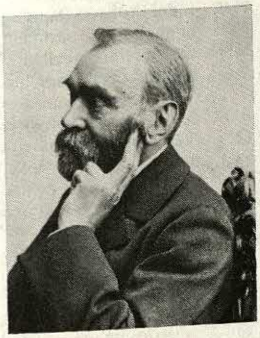
As president of Ghana, Nkrumah worked to develop the economy and improve living conditions. He promoted industrialization, introduced health and welfare programmes, and expanded the educational system. But Nkrumah made enemies with the methods he used to achieve these goals. He imprisoned his opponents. Ghana's economy began to weaken, and corruption became widespread. Army leaders took over the government while Nkrumah was visiting China.

Nkrumah was born in Nkroful, Ghana. He led his country's drive for independence from the United Kingdom in the 1950's. He was prime minister of the Gold Coast, and kept that office when the colony became Ghana, an independent country, in 1957.

Noah, according to the Bible and the Quran, was the only righteous, God-fearing man of his time. Genesis 6-9 tells that he was chosen by God to keep some people and animals alive during the Deluge, or great Flood. Noah warned people for 120 years that the Flood was coming. During that time, he built a ship, called the ark, which was 137 metres long. He took into the ark his family, and enough birds and animals to repopulate the earth. The rain poured for 40 days and 40 nights (Gen. 7:12, 24). Even when the water rose above the highest mountains, the ark floated safely.

The waters dropped enough 150 days after the Flood started that the ark was able to rest on the mountains of Ararat (see **Ararat**). Noah let loose a raven which did not return. Then he sent out a dove, and it returned because it could find no place to perch. Later, he sent out the same dove two more times. On the second flight, it returned with an olive branch in its mouth. Noah and all the animals came out of the ark later to begin a new life. Noah offered sacrifice to God for deliverance, and God promised him that He would never send another flood to destroy the earth. He made the rainbow a sign of that promise.

Noah's sons were Shem, Ham, and Japheth. Shem became father of the *Semitic* peoples, including the Hebrews and the Arabs. Ham was the father of the Hamitic peoples, and Japheth was father of the peoples of Asia Minor and Europe. In traditions originally unrelated to the Flood, Noah is pictured as a gardener, and credited with the discovery of wine (Gen. 9:18-27).



Alfred Nobel

Nobel, Alfred Bernhard (1833-1896), a Swedish chemist, invented dynamite and founded the Nobel Prizes (see **Nobel Prizes**). As a young man, Nobel experimented with nitroglycerin in his father's factory. He hoped to make this dangerous substance into a safe and useful explosive. He prepared a nitroglycerin explosive, but so many accidents occurred when it was put on the market that for a number of years many people considered Nobel almost a public enemy.

Finally, in 1867, Nobel combined nitroglycerin with an absorbent substance. This explosive could be handled and shipped safely. Nobel named it *dynamite* (see **Dynamite**). Within a few years, he became one of the world's richest men. He set up factories throughout the world, and bought the large Bofors armament plant in Sweden. He worked on synthetic rubber, artificial silk, and many other products.

Nobel was never in good health. In later years, he became increasingly ill and nervous. He suffered from a feeling of guilt at having created a substance that caused so much death and injury. He hated the thought that dynamite could be used in war when he had invented it for peace. Nobel set up a fund of about 9 million U.S. dollars. The interest from the fund was to be used to award annual prizes, one of which was for the most effective work in promoting international peace.

Alfred Nobel was born on Oct. 21, 1833, in Stockholm, the son of an inventor. He was educated in St. Petersburg, Russia, and later studied engineering in the United States.

Nobel Prizes are awarded each year to people, regardless of nationality, who have made valuable contributions to the "good of humanity." In his will, the wealthy Swedish inventor Alfred Nobel directed that the income from his estate be used to fund five annual prizes. The awards are given for the most important discoveries or inventions in the fields of physics, chemistry, and physiology or medicine; the most distinguished literary work of an idealistic nature; and the most effective work in the interest of international peace. The prizes were first presented in 1901. A sixth prize—the Bank of Sweden Prize in Economic Sciences in memory of Alfred Nobel—was first awarded in 1969, and is funded by the bank. In the mid 1990's, the value of each prize was about 900,000 U.S. dollars.

The Royal Swedish Academy of Sciences in Stockholm chooses the physics, chemistry, and economics winners. The Nobel Assembly at the Karolinska Institute in Stockholm awards the prize for medicine. The Swedish Academy in Stockholm awards the prize for literature. The Norwegian Nobel Committee elected by the Norwegian *Storting* (parliament) awards the prize for peace.

A candidate may not apply directly for a prize. A qualified person must submit each name in writing. For the literary prize, the Swedish Academy considers only works that have appeared in print. The academy usually selects an author for his or her complete work rather than for one book.

The organizations that award the prizes appoint 15 deputies who elect a board of directors. The board holds office for two years and administers the funds. Winners receive their awards on December 10, the anniversary of the death of Alfred Nobel. The peace prize is awarded in Oslo, Norway. The other prizes are awarded in Stockholm, Sweden. Two or three people may share a prize. Sometimes, prizes are not awarded or are awarded in a later year.

There is a biography in *World Book* of each prizewinner whose name is marked with an asterisk in the *tables* on the following pages.

Alfred Nobel

Nobel Prizes consist of a medal and a cash award. Prizes are awarded for outstanding achievement in chemistry, physics, physiology or medicine, literature, world peace, and economics. The obverse side of each medal has a bust of Alfred Nobel, *left,* a Swedish chemist who established the prizes in the late 1800's. The chemistry and physics medals have identical reverse sides, *right.* The reverse side of each of the other medals is different.

Physics and chemistry

Nobel Prizes for physics

1901 * Wilhelm Roentgen (German) for discovering X rays.

1902 * Hendrik Antoon Lorentz and *Pieter Zeeman (Dutch) for discovering the Zeeman effect of magnetism on light.

1903 * Antoine Henri Becquerel and *Pierre and Marie Curie (French) for discovering radioactivity and studying uranium.

1904 Baron Rayleigh (British) for studying the density of gases and discovering argon.

1905 Philipp Lenard (German) for studying the properties of cathode rays.

1906 * Sir Joseph John Thomson (British) for studying electrical discharge through gases.

1907 * Albert Michelson (American) for his design of precise optical instruments and for accurate measurements.

1908 Gabriel Lippmann (French) for his method of colour photography.

1909 * Guglielmo Marconi (Italian) and Karl Ferdinand Braun (German) for developing the wireless telegraph.

1910 Johannes van der Waals (Dutch) for studying the relationships of liquids and gases.

1911 Wilhelm Wien (German) for his discoveries on the heat radiated by black objects.

1912 Nils Dalén (Swedish) for inventing automatic gas regulators for lighthouses.

1913 Heike Kamerlingh Onnes (Dutch) for experimenting with low temperatures and liquefying helium.

1914 Max von Laue (German) for using crystals to measure X rays.

1915 * Sir William Henry Bragg and Sir William Bragg (British) for using X rays to study crystal structure.

1916 No award

1917 Charles Barkla (British) for studying the diffusion of light and the radiation of X rays from elements.

1918 * Max Planck (German) for stating the quantum theory of light.

1919 * Johannes Stark (German) for discovering the Stark effect of spectra in electric fields.

1920 Charles Guillaume (French) for discovering nickel-steel alloys with slight expansion, and the alloy invar.

1921 * Albert Einstein (German) for contributing to mathematical physics and stating the law of the photoelectric effect.

1922 * Niels Bohr (Danish) for studying the structure of atoms and their radiations.

1923 * Robert Millikan (American) for measuring the charge on electrons and working on the photoelectric effect.

1924 * Karl Siegbahn (Swedish) for working with the X-ray spectroscope.

1925 James Franck and *Gustav Hertz (German) for stating laws on the collision of an electron with an atom.

1926 Jean Baptiste Perrin (French) for studying the discontinuous structure of matter and measuring the sizes of atoms.

1927 Arthur Compton (American) for discovering the Compton effect on X rays reflected from atoms, and Charles Wilson (British) for discovering a method for tracing the paths of ions.

1928 * Owen Richardson (British) for studying thermionic effect and electrons sent off by hot metals.

1929 * Louis Victor de Broglie (French) for discovering the wave character of electrons.

1930 * Sir Chandrasekhara Venkata Raman (Indian) for discovering a new effect in radiation from elements.

1931 No award

1932 * Werner Heisenberg (German) for founding quantum mechanics, which led to discoveries in hydrogen.

1933 * Paul Dirac (British) and *Erwin Schrödinger (Austrian) for discovering new forms of atomic theory.

1934 No award

1935 * Sir James Chadwick (British) for discovering the neutron.

1936 * Carl David Anderson (American) for discovering the positron, and Victor Hess (Austrian) for discovering cosmic rays.

1937 Clinton Davisson (American) and George Thomson (British) for discovering the diffraction of electrons by crystals.

1938 * Enrico Fermi (Italian) for discovering new radioactive elements beyond uranium.

1939 * Ernest Lawrence (American) for inventing the cyclotron and working on artificial radioactivity.

1940-1942 No award

1943 Otto Stern (American) for discovering the molecular beam method of studying the atom.

1944 Isidor Isaac Rabi (American) for recording the magnetic properties of atomic nuclei.

1945 * Wolfgang Pauli (Austrian) for discovering the exclusion principle (Pauli principle) of electrons.

1946 Percy Williams Bridgman (American) for his work in the field of very high pressures.

1947 * Sir Edward Appleton (British) for exploring the ionosphere.

1948 Patrick Blackett (British) for his discoveries in cosmic radiation.

1949 * Hideki Yukawa (Japanese) for predicting the existence of elementary particles called *mesons.*

1950 Cecil Frank Powell (British) for his photographic method of studying atomic nuclei and his discoveries concerning mesons.

1951 * Sir John Cockcroft (British) and *Ernest Walton (Irish) for working on the transmutation of atomic nuclei by artificially accelerated atomic particles.

1952 Felix Bloch and Edward Mills Purcell (American) for developing magnetic measurement methods for atomic nuclei.

1953 Frits Zernike (Dutch) for inventing the phase contrast microscope for cancer research.

1954 * Max Born (German) for research in quantum mechanics, and Walther Bothe (German) for discoveries he made with his coincidence method.

*Has a biography in *World Book.*

Physiology or medicine

Literature

Peace

Economics

Nobel Prizes for physics (continued)

1955 Willis E. Lamb, Jr. (American), for discoveries on the structure of the hydrogen spectrum, and Polykarp Kusch (American) for determining the magnetic moment of the electron.

1956 * John Bardeen, Walter Brattain, and William Shockley (American) for inventing the transistor.

1957 * Tsung Dao Lee and *Chen Ning Yang (American) for disproving the law of conservation of parity.

1958 Pavel Cherenkov, Ilya Frank, and Igor Tamm (Soviet) for discovering and interpreting the Cherenkov effect in studying high-energy particles.

1959 Emilio Segrè and Owen Chamberlain (American) for their work in demonstrating the existence of the antiproton.

1960 Donald Glaser (American) for inventing the bubble chamber to study subatomic particles.

1961 Robert Hofstadter (American) for his studies of nucleons, and *Rudolf Mössbauer (German) for his research on gamma rays.

1962 Lev Davidovich Landau (Soviet) for his research on liquid helium.

1963 Eugene Paul Wigner (American) for his contributions to the understanding of atomic nuclei and the elementary particles, and *Maria Goeppert Mayer (American) and *J. Hans Jensen (German) for their work on the structure of atomic nuclei.

1964 Charles Townes (American) and *Nikolai Basov and *Alexander Prokhorov (Soviet) for developing *masers* and *lasers.*

1965 Sin-itiro Tomonaga (Japanese) and Julian Schwinger and *Richard Feynman (American) for basic work in quantum electrodynamics.

1966 Alfred Kastler (French) for his work on the energy levels of atoms.

1967 * Hans Albrecht Bethe (American) for his contributions to the theory of nuclear reactions, especially his discoveries on the energy production in stars.

1968 * Luis Alvarez (American) for his contributions to the knowledge of subatomic particles.

1969 Murray Gell-Mann (American) for his discoveries concerning the classification of nuclear particles and their interactions.

1970 Hannes Olof Gösta Alfvén (Swedish) for his work in *magnetohydrodynamics,* the study of electrical and magnetic effects in fluids that conduct electricity, and Louis Eugène Félix Néel (French) for his discoveries of magnetic properties that applied to computer memories.

1971 * Dennis Gabor (British) for his work in *holography,* a method of making a three-dimensional photograph with coherent light produced by a laser.

1972 * John Bardeen, Leon Cooper, and John Robert Schrieffer (American) for their work on *superconductivity,* the disappearance of electrical resistance.

1973 Ivar Giaever (American), Leo Esaki (Japanese), and Brian Josephson (British) for their work on the phenomena of electron "tunnelling" through semiconductor and superconductor materials.

1974 Antony Hewish (British) for the discovery of pulsars, and Sir Martin Ryle (British) for his use of small radio telescopes to "see" into space with great accuracy.

1975 L. James Rainwater (American) and Aage Bohr and Ben Mottelson (Danish) for their work on the structure of the atomic nucleus.

1976 Burton Richter and *Samuel Chao Chung Ting (American) for their discovery of an elementary nuclear particle called the *psi,* or *J, particle.*

1977 Philip W. Anderson and John Van Vleck (American) and *Sir Nevill Mott (British) for helping develop semiconductor devices.

1978 * Pyotr Kapitsa (Soviet) for his research in low-temperature physics, and Arno Penzias and Robert Wilson (American) for their discovery and study of cosmic microwave background radiation.

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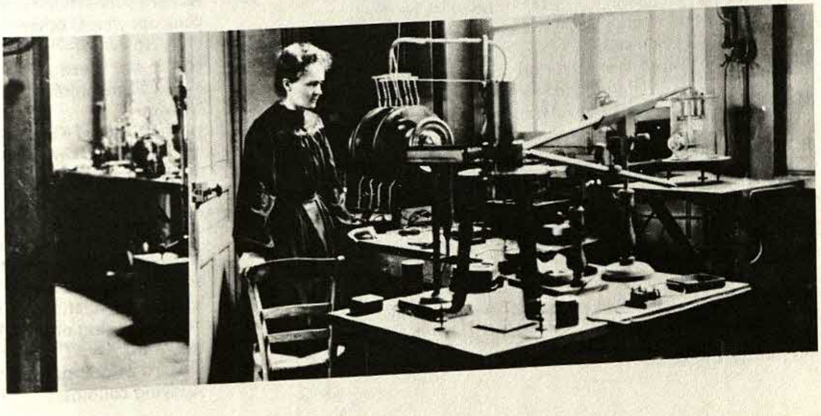
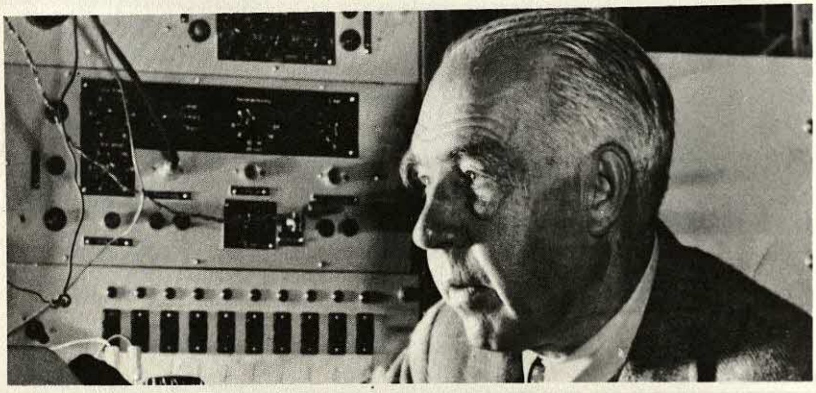
*Has a biography in *World Book.*



Marie Curie shared the 1903 physics prize with her husband, Pierre, and Antoine Becquerel for their discovery of radioactivity and studies of uranium. Marie Curie also won the 1911 chemistry prize for her discovery of and work with the elements radium and polonium.



Niels Bohr, *left,* a Danish physicist, received the Nobel Prize for physics in 1922. Bohr conducted studies of the structure of atoms and the energy radiated by their electrons.

Nobel Prizes for physics (continued)

1979 Sheldon Glashow and Steven Weinberg (American) and Abdus Salam (Pakistani) for developing a principle that unifies the weak nuclear force and the force of electromagnetism.

1980 James Cronin and Val Fitch (American) for their research on subatomic particles revealing that the fundamental laws of symmetry in nature could be violated.

1981 Nicolaas Bloembergen and Arthur Schawlow (American) for their contribution to the development of laser spectroscopy, and Kai Siegbahn (Swedish) for his contribution to the development of high-resolution electron spectroscopy.

1982 Kenneth Wilson (American) for his method of analysing the behaviour of matter when it changes form—for example, from water to steam.

1983 * Subrahmanyan Chandrasekhar and William Fowler (American) for work on the evolution and death of stars.

1984 Carlo Rubbia (Italian) and Simon van der Meer (Dutch) for contributions to the discovery of two subatomic particles—the *W particle* and the *Z particle.*

1985 Klaus von Klitzing (West German) for developing a precise way of measuring electrical resistance.

1986 Ernst Ruska (West German) for his invention of the electron microscope and Gerd Binnig (West German) and Heinrich Rohrer (Swiss) for their invention of the scanning tunnelling microscope.

1987 J. Georg Bednorz (West German) and K. Alex Müller (Swiss) for their discovery of superconductivity in a ceramic material.

1988 Leon Lederman, Melvin Schwartz, and Jack Steinberger (American) for their work on neutrinos.

1989 Hans G. Dehmelt (American) and Wolfgang Paul (German) for isolating and measuring single atoms, and Norman Ramsey (American) for work that led to the atomic clock.

1990 Jerome Friedman and Henry Kendall (American) and Richard Taylor (Canadian) for experiments that proved the existence of subatomic particles called *quarks.*

1991 Pierre-Gilles de Gennes (French) for his analyses of alignments and other orderly arrangements of molecules in certain substances.

1992 Georges Charpak (French) for the invention of devices that detect subatomic particles in particle accelerators.

1993 Russell Hulse and Joseph Taylor, Jr. (American) for discovering dense pairs of stars called *binary pulsars.*

1994 Clifford Shull (American) and Bertram Brockhouse (Canadian) for developing neutron scattering as a technique for revealing the structure of matter.

Nobel Prizes for chemistry

1901 Jacobus Henricus Van't Hoff (Dutch) for discovering laws of chemical dynamics and osmotic pressure.

1902 * Emil Fischer (German) for synthesizing sugars, purine derivatives, and peptides.

1903 Svante August Arrhenius (Swedish) for his dissociation theory of ionization in electrolytes.

1904 * Sir William Ramsay (British) for discovering helium, neon, xenon, and krypton, and determining their place in the periodic system.

1905 Adolph von Baeyer (German) for his work on dyes and organic compounds, and for synthesizing indigo and arsenicals.

1906 Henri Moissan (French) for preparing pure fluorine and developing the electric furnace.

1907 Eduard Buchner (German) for his biochemical researches and for discovering cell-less fermentation.

1908 * Ernest Rutherford (British) for discovering that radioactive elements change into other elements.

1909 * Wilhelm Ostwald (German) for his work on catalysis, chemical equilibrium, and the rate of chemical reactions.

1910 Otto Wallach (German) for his work in the field of alicyclic substances.

1911 * Marie Curie (French) for her discovery of radium and polonium, and for her work in isolating radium and studying the compounds of radium.

1912 François Grignard (French) for discovering the Grignard reagent to synthesize organic compounds, and Paul Sabatier (French) for his method of using nickel as a hydrogenation catalyst.

1913 Alfred Werner (Swiss) for his coordination theory on the arrangement of atoms.

1914 Theodore Richards (American) for determining the atomic weights of many elements.

1915 Richard Willstätter (German) for his research on chlorophyll and other colouring matter in plants.

1916-1917 No award

1918 Fritz Haber (German) for the Haber-Bosch process of synthesizing ammonia from nitrogen and hydrogen.

1919 No award

1920 Walther Nernst (German) for his discoveries concerning heat changes in chemical reactions.

1921 * Frederick Soddy (British) for studying radioactive substances and isotopes.

1922 * Francis Aston (British) for discovering many isotopes by means of the mass spectrograph and discovering the whole number rule on the structure and weight of atoms.

1923 Fritz Pregl (Austrian) for inventing a method of microanalysing organic substances.

1924 No award

1925 Richard Zsigmondy (German) for his method of studying colloids.

*Has a biography in *World Book.*

Nobel Prizes for chemistry (continued)

1926 * Theodor Svedberg (Swedish) for his work on dispersions and on colloid chemistry.
1927 Heinrich Wieland (German) for studying gall acids and related substances.
1928 Adolf Windaus (German) for studying sterols and their connection with vitamins.
1929 Sir Arthur Harden (British) and Hans August Simon von Euler-Chelpin (German) for their research on sugar fermentation and enzymes.
1930 Hans Fischer (German) for studying the colouring matter of blood and leaves and synthesizing hemin.
1931 * Carl Bosch and Friedrich Bergius (German) for inventing high-pressure methods of manufacturing ammonia and liquefying coal.
1932 Irving Langmuir (American) for his discoveries about molecular films absorbed on surfaces.
1933 No award
1934 Harold Clayton Urey (American) for discovering deuterium (heavy hydrogen).
1935 Frédéric and *Irène Joliot-Curie (French) for synthesizing new radioactive elements.
1936 Peter Debye (Dutch) for his studies on molecules, dipole moments, the diffraction of electrons, and X rays in gases.
1937 Sir Walter Haworth (British) for his research on carbohydrates and vitamin C, and Paul Karrer (Swiss) for studying carotenoids, flavins, and vitamins A and B_2.
1938 * Richard Kuhn (German) for his work on carotenoids and vitamins (declined).
1939 Adolph Butenandt (German) for studying sex hormones (declined), and Leopold Ružička (Swiss) for his work on polymethylenes.
1940-1942 No award
1943 Georg von Hevesy (Hungarian) for using isotopes as indicators in chemistry.
1944 * Otto Hahn (German) for his discoveries in fission.
1945 Artturi Virtanen (Finnish) for inventing new methods in agricultural biochemistry.
1946 James B. Sumner (American) for discovering that enzymes can be crystallized, and Wendell M. Stanley and John H. Northrop (American) for preparing pure enzymes and virus proteins.
1947 * Sir Robert Robinson (British) for his research on biologically significant plant substances.
1948 Arne Tiselius (Swedish) for his discoveries on the nature of the serum proteins.
1949 William Francis Giauque (American) for studying reactions to extreme cold.
1950 Otto Diels and Kurt Alder (German) for developing a method of synthesizing organic compounds of the diene group.
1951 Edwin M. McMillan and *Glenn T. Seaborg (American) for discovering plutonium and other elements.
1952 Archer Martin and Richard Synge (British) for developing the partition chromatography process, a method of separating compounds.
1953 Hermann Staudinger (German) for discovering a way to synthesize fibre.
1954 * Linus Pauling (American) for his work on the forces that hold matter together.
1955 Vincent Du Vigneaud (American) for discovering a process for making synthetic hormones.
1956 Sir Cyril Hinshelwood (British) and Nikolai Semenov (Soviet) for their work on chemical chain reactions.
1957 Lord Todd (British) for his work on the protein composition of cells.
1958 * Frederick Sanger (British) for discovering the structure of the insulin molecule.
1959 Jaroslav Heyrovský (Czech) for developing the polarographic method of analysis.
1960 Willard F. Libby (American) for developing a method of radiocarbon dating.
1961 Melvin Calvin (American) for his research on photosynthesis.
1962 Sir John Cowdery Kendrew and *Max Ferdinand Perutz (British) for their studies on globular proteins.
1963 Giulio Natta (Italian) for his contributions to the understanding of *polymers,* and Karl Ziegler (German) for his production of *organometallic compounds.* Their work resulted in improved plastics.
1964 * Dorothy Hodgkin (British) for X-ray studies of compounds such as vitamin B_{12} and penicillin.
1965 Robert Burns Woodward (American) for his contributions to organic synthesis.
1966 * Robert S. Mulliken (American) for developing the *molecular-orbital* theory of chemical structure.
1967 Manfred Eigen (German) and Ronald Norrish and George Porter (British) for developing techniques to measure rapid chemical reactions.
1968 Lars Onsager (American) for developing the theory of reciprocal relations of various kinds of thermodynamic activity.
1969 Derek Barton (British) and Odd Hassel (Norwegian) for studies relating chemical reactions with the three-dimensional shape of molecules.
1970 Luis Federico Leloir (Argentine) for his discovery of chemical compounds that affect the storage of chemical energy in living things.
1971 Gerhard Herzberg (Canadian) for his research in the structure of molecules, particularly for his work on molecular fragments called *free radicals.*
1972 Christian B. Anfinsen, Stanford Moore, and William H. Stein (American) for their fundamental contributions to the chemistry of enzymes.
1973 Geoffrey Wilkinson (British) and Ernst Fischer (German) for their work on *organometallic compounds,* substances which consist of organic compounds and metal atoms.
1974 Paul John Flory (American) for his work in polymer chemistry.
1975 John Warcup Cornforth (Australian-born) and Vladimir Prelog (Swiss) for their work on the chemical synthesis of important organic compounds.
1976 William Lipscomb, Jr. (American), for his studies on the structure and bonding mechanisms of *boranes,* complex compounds of boron and hydrogen.
1977 Ilya Prigogine (Belgian) for his contributions to nonequilibrium thermodynamics.
1978 Peter Mitchell (British) for his studies of cellular energy transfer.
1979 Herbert Brown (American) and Georg Wittig (German) for developing compounds capable of producing chemical bonds useful in the manufacture of drugs and in other industrial processes.
1980 Paul Berg and Walter Gilbert (American) and *Frederick Sanger (British) for their studies of the chemical structure of nucleic acids.
1981 Kenichi Fukui (Japanese) and Roald Hoffmann (American) for applying the theories of quantum mechanics to predict the course of chemical reactions.
1982 Aaron Klug (South African-born) for his work with the electron microscope and for his research into the structure of nucleic acid-protein complexes.
1983 Henry Taube (American) for his research on the transfer of electrons between molecules in chemical reactions.
1984 R. Bruce Merrifield (American) for developing a method for making *peptides,* the building blocks of proteins.
1985 Herbert A. Hauptman and Jerome Karle (American) for developing techniques for quickly determining the chemical structure of molecules vital to life.
1986 Dudley Herschbach and Yuan Lee (American) and John Polanyi (Canadian) for work on chemical reactions.

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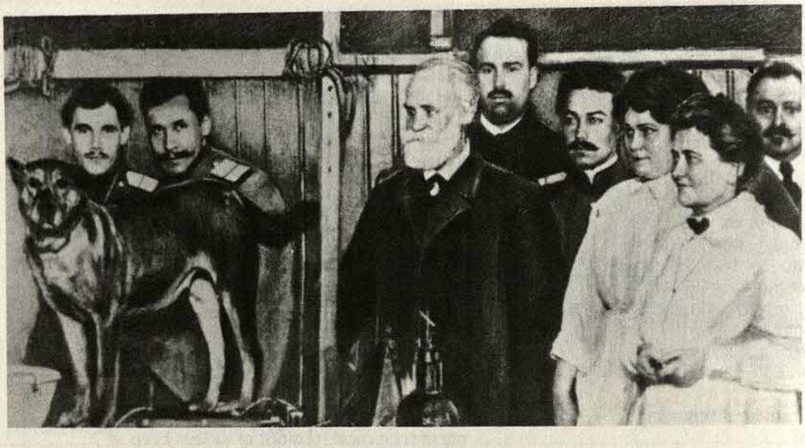

Ivan Petrovich Pavlov, a Russian physiologist, won the 1904 prize in physiology or medicine. Pavlov and his staff experimented with dogs to learn how nerves affect the process of digestion.

Nobel Prizes for chemistry (continued)

1987 Jean-Marie Lehn (French) and Donald Cram and Charles Pedersen (American) for their development of, and work with, artificial molecules.
1988 Johann Deisenhofer, Robert Huber, and Hartmut Michel (West German) for revealing the structure of proteins that are essential to photosynthesis.
1989 Sidney Altman and Thomas Cech (American) for their discovery that ribonucleic acid (RNA) can aid chemical reactions in cells.
1990 Elias James Corey (American) for developing techniques for artificially duplicating natural substances as compounds for use as drugs.
1991 Richard Ernst (Swiss) for improvements in the use of nuclear magnetic resonance (NMR) to analyse chemicals.
1992 Rudolph Marcus (American) for analysing the transfer of electrons between molecules.
1993 Michael Smith (Canadian) and Kary Mullis (American) for devising methods that made possible gene therapy, detection of the AIDS virus, and multiplication of fossil DNA.
1994 Professor George Olah (American) for his work on hydrocarbon molecules.

Nobel Prizes for physiology or medicine

1901 * Emil von Behring (German) for discovering the diphtheria antitoxin.
1902 * Sir Ronald Ross (British) for working on malaria and discovering how malaria is transmitted.
1903 Niels Ryberg Finsen (Danish) for treating diseases, especially *lupus vulgaris,* with concentrated light rays.
1904 * Ivan Petrovich Pavlov (Russian) for his work on the physiology of digestion.
1905 * Robert Koch (German) for working on tuberculosis and discovering the tubercule bacillus and tuberculin.
1906 * Camillo Golgi (Italian) and Santiago Ramon y Cajal (Spanish) for their studies of nerve tissue.
1907 * Charles Louis Alphonse Laveran (French) for studying diseases caused by protozoans.
1908 * Paul Ehrlich (German) and *Élie Metchnikoff (Russian) for their work on immunity.
1909 * Emil Theodor Kocher (Swiss) for his work on the physiology, pathology, and surgery of the thyroid gland.
1910 Albrecht Kossel (German) for studying cell chemistry, proteins, and nucleic substances.
1911 Allvar Gullstrand (Swedish) for his work on dioptrics, the refraction of light through the eye.
1912 Alexis Carrel (French) for suturing blood vessels and grafting vessels and organs.
1913 Charles Robert Richet (French) for studying allergies caused by foreign substances, as in hay fever.
1914 Robert Bárány (Austrian) for work on function and diseases of equilibrium organs in the inner ear.
1915-1918 No award
1919 Jules Bordet (Belgian) for discoveries on immunity.
1920 August Krogh (Danish) for discovering the system of action of blood capillaries.
1921 No award
1922 * Archibald Hill (British) for his discovery on heat production in the muscles, and Otto Meyerhof (German) for his theory on lactic acid in the muscles.
1923 * Sir Frederick Banting (Canadian) and *John Macleod (Scottish) for discovering insulin.
1924 * Willem Einthoven (Dutch) for his discovery of the way electrocardiography works.
1925 No award
1926 Johannes Fibiger (Danish) for discovering a parasite that causes cancer.
1927 Julius Wagner von Jauregg (Austrian) for discovering the fever treatment for paralysis.
1928 Charles Nicolle (French) for his work on typhus.
1929 Christiaan Eijkman (Dutch) for discovering vitamins that prevent beriberi, and *Sir Frederick Hopkins (British) for discovering vitamins that help growth.
1930 Karl Landsteiner (American) for discovering the four main human blood types.
1931 Otto Warburg (German) for discovering that enzymes aid in respiration by tissues.
1932 Edgar Adrian and Sir Charles Sherrington (British) for discoveries on the function of neurons.
1933 * Thomas Morgan (American) for studying the function of chromosomes in heredity.
1934 * George Minot, William Murphy, and George Whipple (American) for their discoveries on liver treatment for anaemia.
1935 Hans Spemann (German) for discovering the organizer-effect in the growth of an embryo.
1936 Sir Henry Dale (British) and Otto Loewi (Austrian) for their discoveries on the chemical transmission of nerve impulses.
1937 Albert Szent-Györgyi (Hungarian) for his work on oxidation in tissues, vitamin C, and fumaric acid.
1938 Corneille Heymans (Belgian) for his discoveries concerning the regulation of respiration.
1939 * Gerhard Domagk (German) for discovering Prontosil, the first sulpha drug (declined).

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*Has a biography in *World Book.*

Nobel Prizes for physiology or medicine (continued)

1940-1942 No award

1943 Henrik Dam (Danish) for discovering vitamin K, and Edward Doisy (American) for synthesizing it.

1944 Joseph Erlanger and Herbert Gasser (American) for their work on single nerve fibres.

1945 * Alexander Fleming (British) for discovering penicillin, and *Howard Florey and *Ernst Chain (British) for developing its use as an antibiotic.

1946 * Hermann Joseph Muller (American) for discovering that X rays can produce mutations.

1947 Carl and Gerty Cori (American) for their work on insulin, and Bernardo Houssay (Argentine) for studying the pancreas and the pituitary gland.

1948 * Paul Müller (Swiss) for discovering the insect-killing properties of DDT.

1949 Walter Hess (Swiss) for discovering how certain parts of the brain control organs of the body, and Antônio Moniz (Portuguese) for originating prefrontal lobotomy.

1950 Philip S. Hench, Edward C. Kendall (American), and Tadeus Reichstein (Swiss) for their discoveries on cortisone and ACTH.

1951 * Max Theiler (South African who worked in the United States) for developing the yellow fever vaccine known as 17-D.

1952 Selman A. Waksman (American) for his work in the discovery of streptomycin.

1953 Fritz Albert Lipmann (American) and *Hans Adolf Krebs (British) for their discoveries in biosynthesis and metabolism.

1954 * John F. Enders, Thomas H. Weller, and Frederick C. Robbins (American) for discovering a simple method of growing polio virus in test tubes.

1955 Hugo Theorell (Swedish) for his discoveries on the nature and action of oxidation enzymes.

1956 André F. Cournand, Dickinson W. Richards, Jr. (American), and Werner Forssmann (German) for using a catheter to chart the interior of the heart.

1957 Daniel Bovet (Italian) for discovering antihistamines.

1958 * George Wells Beadle and Edward Lawrie Tatum (American) for their work in biochemical genetics, and *Joshua Lederberg (American) for his studies of genetics in bacteria.

1959 Severo Ochoa and Arthur Kornberg (American) for producing nucleic acid by artificial means.

1960 * Sir Macfarlane Burnet (Australian) and Peter Medawar (British) for research in transplanting organs.

1961 Georg von Békésy (American) for demonstrating how the ear distinguishes between various sounds.

1962 * James D. Watson (American) and *Francis Crick and *Maurice Wilkins (British) for their work on nucleic acid.

1963 * Sir John Carew Eccles (Australian) for his research on the transmission of nerve impulses, and *Alan Lloyd Hodgkin (British) and Andrew Fielding Huxley (British) for their description of the behaviour of nerve impulses.

1964 Konrad E. Bloch (American) and *Feodor Lynen (German) for their work on cholesterol and fatty acid metabolism.

1965 François Jacob, André Lwoff, and Jacques Monod (French) for their discoveries concerning genetic control of enzyme and virus synthesis.

1966 * Francis Peyton Rous (American) for discovering a cancer-producing virus, and Charles B. Huggins (American) for discovering uses of hormones in treating cancer.

1967 Ragnar Granit (Swedish) and H. Keffer Hartline and George Wald (American) for their work on chemical and physiological processes in the eye.

1968 Robert W. Holley, H. Gobind Khorana, and Marshall W. Nirenberg (American) for explaining how genes determine the function of cells.

1969 Max Delbrück, Alfred Hershey, and Salvador Luria (American) for their work with *bacteriophages* (viruses that attack bacteria).

1970 Julius Axelrod (American), Bernard Katz (British), and Ulf Svante von Euler (Swedish) for their discoveries of the role played by certain chemicals in the transmission of nerve impulses.

1971 Earl W. Sutherland, Jr. (American), for his discovery of the ways hormones act, including the discovery of cyclic AMP, a chemical that influences the actions of hormones on body processes.

1972 Gerald M. Edelman (American) and Rodney Porter (British) for their discovery of the chemical structure of antibodies.

1973 * Nikolaas Tinbergen (Dutch-born) and *Konrad Lorenz and *Karl von Frisch (Austrian) for their studies on animal behaviour.

1974 Christian de Duve (Belgian) and Albert Claude and George E. Palade (American) for their pioneer work in cell biology.

1975 David Baltimore, Renato Dulbecco, and Howard M. Temin (American) for their research on how certain viruses affect the genes of cancer cells.

1976 Baruch S. Blumberg and D. Carleton Gajdusek (American) for their discoveries concerning the origin and spread of infectious diseases.

1977 Roger Guillemin, Andrew Schally, and Rosalyn Yalow (American) for their research into hormones.

1978 Werner Arber (Swiss) and Daniel Nathans and Hamilton O. Smith (American) for their discoveries in molecular genetics.

1979 Allan MacLeod Cormack (American) and Godfrey Newbold Hounsfield (British) for their contributions to the development of the computerized tomographic (CT) scanner.

1980 Baruj Benacerraf and George D. Snell (American) and Jean Dausset (French) for their discoveries about the genetic regulation of the body's immune system.

1981 Roger W. Sperry and David H. Hubel (American) and Torsten Wiesel (Swedish) for their research on the organization and functioning of the brain.

1982 Sune Bergstrom and Bengt Samuelsson (Swedish) and John Vane (British) for their discoveries regarding prostaglandins and related substances.

1983 Barbara McClintock (American) for her discovery that genes sometimes behave unexpectedly inside cells.

1984 Niels Jerne (British), Georges Köhler (German), and Cesar Milstein (Argentine) for discoveries in immunology.

1985 Michael S. Brown and Joseph L. Goldstein (American) for explaining how high cholesterol causes heart disease.

1986 Stanley Cohen (American) and Rita Levi-Montalcini (Italian-born) for their research on cell and organ growth.

1987 Susumu Tonegawa (Japanese) for discovering how genes produce antibodies against specific disease agents.

1988 Gertrude B. Elion and George H. Hitchings (American) and Sir James Black (British) for their discoveries of important principles for drug treatment.

1989 J. Michael Bishop and Harold E. Varmus (American) for research on cancer-causing genes called *oncogenes.*

1990 Joseph E. Murray and E. Donnall Thomas (American) for work in transplanting human organs and bone marrow.

1991 Erwin Neher and Bert Sakmann (German) for discovering how cells communicate with one another.

1992 Edmond Fischer and Edwin Krebs (American) for discovering a chemical process in cells that is linked to cancer and to rejection of transplanted organs.

1993 Richard Roberts (British-born) and Phillip Sharp (American) for their discoveries about the structure and function of genes.

1994 Alfred Gilman and Martin Rodbell (Americans) for discovering G-proteins—molecules that carry messages between cells.

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*Has a biography in *World Book.*

Nobel Prizes for literature

1901 * René Sully-Prudhomme (French) for his poems.
1902 Theodor Mommsen (German) for his historical narratives, particularly his history of Rome.
1903 * Bjørnstjerne Bjørnson (Norwegian) for his novels, poems, and dramas.
1904 * Frédéric Mistral (French) for his poems, and José Echegaray y Eizaguirre (Spanish) for his dramas.
1905 * Henryk Sienkiewicz (Polish) for his novels.
1906 * Giosuè Carducci (Italian) for his poems.
1907 * Rudyard Kipling (British) for his stories, novels, and poems.
1908 Rudolf Eucken (German) for his philosophic writings.
1909 * Selma Lagerlöf (Swedish) for her novels and poems.
1910 Paul von Heyse (German) for his poems, novels, and dramas.
1911 * Maurice Maeterlinck (Belgian) for his dramas.
1912 * Gerhart Hauptmann (German) for his dramas.
1913 * Rabindranath Tagore (Indian) for his poems.
1914 No award
1915 * Romain Rolland (French) for his novels.
1916 Verner von Heidenstam (Swedish) for his poems.
1917 Karl Gjellerup (Danish) for his poems and novels, and Henrik Pontoppidan (Danish) for his novels and short stories.
1918 No award
1919 Carl Spitteler (Swiss) for his epics, short stories, and essays.
1920 * Knut Hamsun (Norwegian) for his novels.
1921 * Anatole France (French) for his novels, short stories, and essays.
1922 * Jacinto Benavente (Spanish) for his dramas.
1923 * William Butler Yeats (Irish) for his poems.
1924 Wladyslaw Reymont (Polish) for his novels.
1925 * George Bernard Shaw (Irish-born) for his plays.
1926 Grazia Deledda (Italian) for her novels.
1927 * Henri Bergson (French) for his philosophic writings.
1928 *Sigrid Undset (Norwegian) for her novels.
1929 * Thomas Mann (German) principally for his novel, *Buddenbrooks.*
1930 * Sinclair Lewis (American) for his novels.
1931 Erik Axel Karlfeldt (Swedish) for his lyric poetry.
1932 * John Galsworthy (British) for his novels, plays, and short stories.
1933 * Ivan Bunin (Soviet) for his novels, short stories, and poems.
1934 * Luigi Pirandello (Italian) for his dramas.
1935 No award
1936 * Eugene O'Neill (American) for his dramas.
1937 * Roger Martin du Gard (French) for his novels.
1938 * Pearl S. Buck (American) for her novels.
1939 Frans Eemil Sillanpää (Finnish) for his novels.
1940-1943 No award
1944 Johannes Jensen (Danish) for his poems and novels.
1945 * Gabriela Mistral (Chilean) for her poems.
1946 * Hermann Hesse (German) for his novels, poems, and essays.
1947 * André Gide (French) for his novels.
1948 * T. S. Eliot (British) for his poems, essays, and plays.
1949 * William Faulkner (American) for his novels. (Award delayed until 1950.)
1950 * Bertrand Russell (British) for his philosophic writings.
1951 * Pär Fabian Lagerkvist (Swedish) for his novels, particularly ***Barabbas.***
1952 * François Mauriac (French) for his novels, essays, and poems.
1953 * Sir Winston Churchill (British) for his essays, speeches, and historical writings.
1954 * Ernest Hemingway (American) for his novels and short stories.
1955 Halldór Laxness (Icelandic) for his novels.
1956 * Juan Ramón Jiménez (Spanish) for his poems.
1957 * Albert Camus (French) for his novels.
1958 * Boris Pasternak (Soviet) for his novels, especially *Dr. Zhivago* (declined).
1959 * Salvatore Quasimodo (Italian) for his lyric poems.
1960 * Saint-John Perse (French) for his poems.
1961 Ivo Andrić (Yugoslav) for his novels, especially *The Bridge on the Drina.*
1962 * John Steinbeck (American) for his novels, especially *The Winter of Our Discontent.*
1963 George Seferis (Greek) for his lyric poetry.
1964 * Jean-Paul Sartre (French) for his philosophical works (declined).
1965 * Mikhail Sholokhov (Soviet) for his novels.
1966 * Shmuel Yosef Agnon (Israeli) for his stories of Eastern European Jewish life, and *Nelly Sachs (German-born) for her poetry and plays about the Jewish people.
1967 * Miguel Angel Asturias (Guatemalan) for his writings rooted in national individuality and Indian traditions.
1968 Yasunari Kawabata (Japanese) for his novels.
1969 * Samuel Beckett (Irish-born) for his novels and plays.
1970 * Alexander Solzhenitsyn (Soviet) for his novels.
1971 * Pablo Neruda (Chilean) for his poems.

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*Has a biography in *World Book.*

Sinclair Lewis became the first American to win the literature prize. He received the award in 1930 for his satirical novels.

André Gide of France won the 1947 literature prize for his novels. *The Counterfeiters* was one of his most famous books.

Nobel Prizes for literature (continued)

1972 *Heinrich Böll (German) for his novels, short stories, and plays.

1973 *Patrick White (Australian) for his novels.

1974 Eyvind Johnson (Swedish) for his novels and short stories, and Harry Edmund Martinson (Swedish) for his essays, plays, novels, and poems.

1975 Eugenio Montale (Italian) for his poems.

1976 *Saul Bellow (American) for his novels.

1977 *Vicente Aleixandre (Spanish) for his poems.

1978 *Isaac Bashevis Singer (Polish-born) for his novels and short stories.

1979 Odysseus Elytis (Greek) for his poems.

1980 Czeslaw Milosz (Polish) for his poems.

1981 Elias Canetti (Bulgarian-born) for his fiction and nonfiction.

1982 Gabriel García Márquez (Colombian) for his novels and short stories.

1983 *Sir William Golding (British) for his novels.

1984 Jaroslav Seifert (Czech) for his poems.

1985 Claude Simon (French) for his novels.

1986 Wole Soyinka (Nigerian) for his plays, poems, and novels.

1987 Joseph Brodsky (Soviet-born) for his poems.

1988 Najib Mahfuz (Egyptian) for his novels and short stories.

1989 Camilo José Cela (Spanish) for his novels.

1990 *Octavio Paz (Mexican) for his poems and essays.

1991 *Nadine Gordimer (South African) for her novels and short stories.

1992 *Derek Walcott (St. Lucian-born) for his poetry.

1993 *Toni Morrison (American) for her novels.

1994 Kenzaburo Oe (Japanese) for his novels.

Nobel Prizes for peace

1901 *Jean Henri Dunant (Swiss) for founding the Red Cross and originating the Geneva Convention, and Frédéric Passy (French) for founding a French peace society.

1902 Élie Ducommun (Swiss) for his work as honorary secretary of the International Peace Bureau, and Charles Albert Gobat (Swiss) for his work as administrator of the Inter-Parliamentary Union.

1903 *Sir William Cremer (British) for his activities as founder and secretary of the International Arbitration League.

1904 The Institute of International Law for its studies on the laws of neutrality and other phases of international law.

1905 Baroness Bertha von Suttner (Austrian) for promoting pacifism and founding an Austrian peace society.

1906 *Theodore Roosevelt (American) for negotiating peace in the Russo-Japanese War.

1907 Ernesto Moneta (Italian) for his work as president of the Lombard League for Peace, and Louis Renault (French) for his work on peace conferences.

1908 Klas Pontus Arnoldson (Swedish) for founding the Swedish Society for Arbitration and Peace, and Fredrik Bajer (Danish) for his work on the International Peace Bureau.

1909 Auguste Beernaert (Belgian) for his work on the Permanent Court of Arbitration, and Paul d'Estournelles (French) for founding and directing the French Parliamentary Arbitration Committee and League of International Conciliation.

1910 The International Peace Bureau for promoting international arbitration and organizing peace conferences.

1911 Tobias Asser (Dutch) for organizing conferences on international law, and Alfred Fried (Austrian) for his writings on peace as editor of *Die Friedenswarte.*

1912 *Elihu Root (American) for settling the problem of Japanese immigration to California and organizing the Central American Peace Conference.

1913 Henri Lafontaine (Belgian) for his work as president of the International Peace Bureau.

1914-1916 No award

1917 The International Red Cross for doing relief work during World War I.

1918 No award

1919 *Woodrow Wilson (American) for attempting a just settlement of World War I and advocating the League of Nations. (Award delayed until 1920.)

1920 Léon Bourgeois (French) for his contribution as president of the Council of the League of Nations.

1921 Karl Hjalmar Branting (Swedish) for promoting social reforms in Sweden and serving as the Swedish delegate to the League of Nations, and Christian Louis Lange (Norwegian) for his contribution as secretary-general of the Inter-Parliamentary Union.

1922 *Fridtjof Nansen (Norwegian) for doing relief work among Russian prisoners of war and in famine areas in Russia.

1923-1924 No award

1925 Sir Austen Chamberlain (British) for helping to work out the Locarno Peace Pact, and Charles G. Dawes (American) for originating a plan for payment of German reparations.

1926 Aristide Briand (French) for his part in forming the Locarno Peace Pact, and Gustav Stresemann (German) for persuading Germany to accept plans for reparations.

1927 Ferdinand Buisson (French) for his work as president of the League of Human Rights, and Ludwig Quidde (German) for writing on and working for peace.

1928 No award

1929 *Frank Billings Kellogg (American) for negotiating the Kellogg-Briand Peace Pact.

1930 Nathan Söderblom (Swedish) for writing on and working for peace.

1931 *Jane Addams (American) for her work with the Women's International League for Peace and Freedom, and *Nicholas M. Butler (American) for his work with the Carnegie Endowment for International Peace.

1932 No award

1933 Sir Norman Angell (British) for his work with the Royal Institute of International Affairs, the League of Nations, and the National Peace Council.

1934 *Arthur Henderson (British) for his contribution as president of the World Disarmament Conference.

1935 Carl von Ossietzky (German) for promoting world disarmament. (Award delayed until 1936.)

1936 Carlos Saavedra Lamas (Argentine) for negotiating a peace settlement between Bolivia and Paraguay in the Chaco War.

1937 Edgar Algernon Robert Gascoyne Cecil (British) for promoting the League of Nations and working with peace movements.

1938 The International Office for Refugees for directing relief work among refugees.

1939-1943 No award

1944 The International Red Cross for doing relief work during World War II.

1945 *Cordell Hull (American) for his peace efforts as secretary of state.

1946 John R. Mott (American) for his YMCA work and for aiding displaced persons, and *Emily Greene Balch (American) for her work with the Women's International League for Peace and Freedom.

1947 The Friends Service Council and the American Friends Service Committee for humanitarian work.

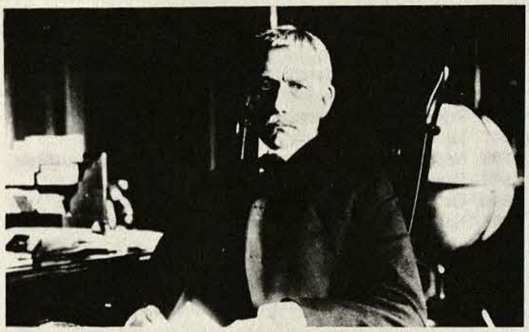
1948 No award

1949 John Boyd Orr (British) for directing the United Nations Food and Agriculture Organization.

1950 *Ralph J. Bunche (American) for his work as UN mediator in Palestine in 1948 and 1949.

1951 Léon Jouhaux (French) for his work helping to organize national and international trade unions.

*Has a biography in _World Book._



Elihu Root won the Nobel Peace Prize in 1912. As U.S. secretary of state, Root made important contributions to world peace.

Woodrow Wilson won the 1919 peace prize, the second awarded to a U.S. president. Theodore Roosevelt won in 1906.

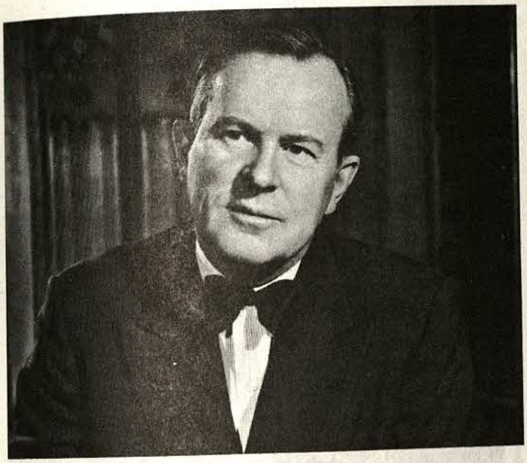
Jane Addams, an American social worker, shared the 1931 peace prize for her work with an international peace group.

Albert Schweitzer won the 1952 Nobel Peace Prize. He devoted most of his life to humanitarian work in Africa.

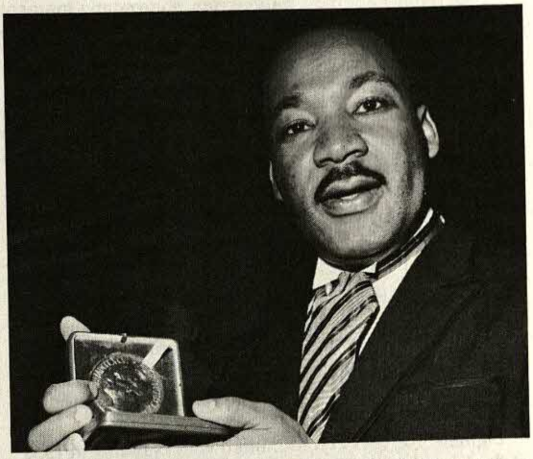
Nobel Prizes for peace (continued)

1952 * Albert Schweitzer (German-born) for his humanitarian work in Africa. (Award delayed until 1953.)
1953 * George Marshall (American) for promoting peace through the European Recovery Program.
1954 Office of the United Nations High Commissioner for Refugees for providing protection for millions of refugees and seeking permanent solutions to their problems. (Award delayed until 1955.)
1955-1956 No award
1957 * Lester Pearson (Canadian) for organizing a United Nations force in Egypt.
1958 Dominique Georges Pire (Belgian) for his work in resettling displaced persons.
1959 * Lord Noel-Baker (British) for his work in promoting peace and disarmament.
1960 * Albert John Luthuli (African) for his peaceful campaign against racial restrictions in South Africa.
1961 * Dag Hammarskjöld (Swedish) for his efforts to bring peace to the Congo (awarded posthumously).
1962 * Linus Pauling (American) for efforts to ban nuclear weapons, especially his campaign against nuclear weapons testing.
1963 International Committee of the Red Cross and League of Red Cross Societies for humanitarian work.
1964 * Martin Luther King, Jr. (American), for leading the black struggle for equality in the United States through nonviolent means.
1965 United Nations Children's Fund (UNICEF) for its aid to children.
1966-1967 No award
1968 René Cassin (French) for promoting human rights.
1969 * International Labour Organization (ILO) for its efforts to improve working conditions.
1970 * Norman Borlaug (American) for his role in developing high-yield grains that increased food production in developing countries.
1971 * Willy Brandt (German) for his efforts to improve relations between Communist and non-Communist nations.
1972 No award
1973 * Henry Kissinger (American) and Le Duc Tho (North Vietnamese) for their work in negotiating the Vietnam War cease-fire agreement (Le Duc Tho declined).
1974 * Sean MacBride (Irish) for working to guarantee human rights through international law, and *Eisaku Sato (Japanese) for his efforts to improve international relations and stop the spread of nuclear weapons.
1975 * Andrei Sakharov (Soviet) for his work in promoting peace and opposing violence and brutality.
1976 Mairead Corrigan and Betty Williams (Irish) for organizing a movement to end Protestant-Catholic fighting in Northern Ireland. (Award delayed until 1977.)
1977 Amnesty International for helping political prisoners.
1978 * Menachem Begin (Israeli) and *Anwar el-Sadat (Egyptian) for their efforts to end the Arab-Israeli conflict.
1979 * Mother Teresa (Indian) for aiding India's poor.
1980 Adolfo Pérez Esquivel (Argentine) for his role in Service for Peace and Justice in Latin America, a group promoting the cause of human rights.
1981 Office of the United Nations High Commissioner for Refugees for protection of millions of Vietnamese and other refugees.

*Has a biography in *World Book*.



Lester Pearson was the first Canadian to win the peace prize. He won the 1957 award for his work in the United Nations.



Martin Luther King, Jr., won the 1964 peace prize for leading nonviolent civil rights demonstrations in the United States.

Nobel Prizes for peace (continued)

1982 * Alva Myrdal (Swedish) and Alfonso García Robles (Mexican) for their contributions to United Nations disarmament negotiations.
1983 * Lech Walesa (Polish) for his efforts to prevent violence while trying to gain workers' rights.
1984 * Desmond Tutu (South African) for leading a nonviolent campaign against ethnic segregation in his country.
1985 International Physicians for the Prevention of Nuclear War for educating the public on the effects of nuclear war.
1986 * Elie Wiesel (American) for his efforts to help victims of oppression and racial discrimination.
1987 Oscar Arias Sánchez (Costa Rican) for authoring a plan to end civil wars in Central America.
1988 UN peacekeeping forces for controlling military conflict.
1989 * Dalai Lama (Tibetan) for his nonviolent struggle to end China's rule of Tibet.
1990 * Mikhail Gorbachev (Soviet) for promoting world peace.
1991 Daw Aung San Suu Kyi (Burmese) for her nonviolent struggle for democracy and human rights in Burma.
1992 Rigoberta Menchú (Guatemalan) for her work to gain respect for the rights of Guatemala's Native Americans.
1993 * Nelson Mandela and *F. W. De Klerk (South African) for helping to integrate South Africa.
1994 Yasir Arafat (Palestinian), Yitzhak Rabin (Israeli) and Shimon Peres (Israeli) for helping to promote Palestinian self-rule.

Nobel Prizes for economics

1969 * Ragnar Frisch (Norwegian) and *Jan Tinbergen (Dutch) for their work in *econometrics,* a method of analysing economic activity.
1970 Paul Samuelson (American) for raising the level of scientific analysis in economic theory.
1971 Simon Kuznets (American) for his interpretation of economic growth.
1972 Kenneth Arrow (American) and Sir John Hicks (British) for their pioneering contribution to general equilibrium theory and to welfare theory.
1973 Wassily Leontief (American) for his development of the input-output method of economic analysis.
1974 Friedrich von Hayek (Austrian) and *Gunnar Myrdal (Swedish) for their work on the theory of money and economic change and on the relationship between economic and social factors.
1975 Leonid Kantorovich (Soviet) and Tjalling Koopmans (American) for their work on economic resources.
1976 Milton Friedman (American) for his work in the fields of economic consumption, monetary history and theory, and price stabilization policy.
1977 James Meade (British) and Bertil Ohlin (Swedish) for their studies of international trade and finance.
1978 Herbert Simon (American) for his research on the decision-making process in business.
1979 Sir Arthur Lewis (St. Lucian-born) and Theodore Schultz (American) for their research into the economic problems of developing countries.
1980 Lawrence Klein (American) for using econometric models to analyse economic policies and the rise and fall in business activity.
1981 James Tobin (American) for his analyses of financial markets and their effect on how businesses and families spend and save money.
1982 George Stigler (American) for his research on industrial organization, markets, and regulation.
1983 Gerard Debreu (American) for his development of a mathematical model that proved supply and demand theory.
1984 Sir Richard Stone (British) for developing methods of measuring the performance of national economies.
1985 Franco Modigliani (American) for his theories on personal savings and financial markets.
1986 James Buchanan (American) for developing methods of analysing the decision-making process in government.
1987 Robert Solow (American) for developing a mathematical model that identified technology as the dominant factor in long-term economic growth.
1988 Maurice Allais (French) for his theories on economic markets and the efficient use of resources.
1989 Trygve Haavelmo (Norwegian) for his development of statistical techniques that led to the creation of mathematical models used in making economic predictions.
1990 Harry Markowitz, Merton Miller, and William Sharpe (American) for theories in corporate finance.
1991 Ronald Coase (British-born) for his theories on property rights and business transactions.
1992 Gary Becker (American) for extending economic theory to aspects of human behaviour.
1993 Robert Fogel and Douglas North (American) for their work on cyclical economic trends.
1994 John Nash and John Harsanyi (Americans) and Reinhard Selten (German) for their work on game theory.

*Has a biography in *World Book.*

Nobelium is an artificially created radioactive element. Its chemical symbol is No. It has an atomic number of 102. Nobelium has 10 known *isotopes.* The isotopes of an element have different numbers of neutrons in their atoms, and so vary in atomic weight. The most stable isotope has a mass number of 259 and a half-life of 58 minutes (see **Radioactivity** [Half-life]). Nobelium can be produced only in amounts too small to weigh.

The discovery of element 102 was a subject of controversy. In 1957, scientists at the Nobel Institute for Physics in Stockholm, Sweden, bombarded curium with carbon 13. The result appeared to be an isotope of element 102, with a mass number of 254 and a half-life of 10 minutes. They named the element nobelium in honour of Swedish inventor Alfred Nobel and the Nobel Institute. But later experiments in the Soviet Union and the United States did not confirm the discovery.

Element 102 was first identified with certainty in 1958 at the Lawrence Radiation Laboratory in Berkeley, California, U.S.A. Scientists bombarded curium with carbon 12. They produced an isotope with a mass number of 254 and a half-life of 55 seconds. The Berkeley team had the right to name the element they had produced. In 1967, they decided to keep the name nobelium.

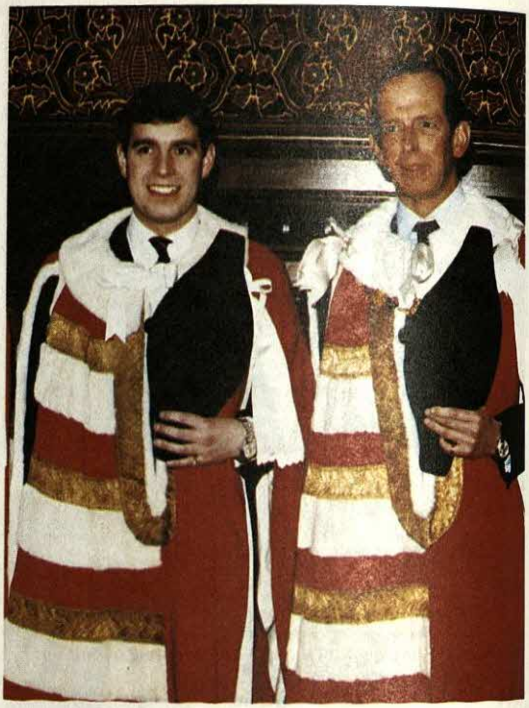
Nobility is a class of people who are considered to stand at the top of their society. They have special political and social status. Nobility is inherited, and it carries titles such as *duke* or *earl.* Some of the nobility are the descendants of lords of the Middle Ages and have inherited their property as well as their titles. Others trace their ancestry to a person who was awarded a title for service to a modern monarch.

Nobility in the United Kingdom (UK) is called the *peerage,* and noblemen are known as *peers.* There are five grades of peers. From highest to lowest, they are: (1) duke; (2) marquess, or marquis; (3) earl; (4) viscount; and (5) baron. The wives of noblemen, and women who hold titles in their own right, are called *peeresses.* The five grades of peeresses are: (1) duchess, (2) marchioness, (3) countess, (4) viscountess, and (5) baroness.

The title of earl is the oldest grade of peer. It dates back to the Danish nobles who ruled much of England from the 800's to the 1000's. The rank of baron was introduced by the Normans when they conquered England in 1066. King Edward III of England created the rank of duke in 1337, when he named his oldest son the Duke of Cornwall. The title of marquess was added to the peerage in 1385, and the first viscount was created in 1440.

Privileges of the peerage. All peers who are at least 21 years old—except peers of Ireland and individuals who have been declared bankrupt or insane—are summoned to the House of Lords. The House of Lords is the upper house of the UK Parliament. Peers are summoned because of the feudal agreement that lords and vassals should consult on important business. Women who are peeresses in their own right also serve in the House of Lords. Peers cannot serve in the lower house of Parliament, the House of Commons.

Peers are exempt from jury duty. They also have a privilege called *immunity from attachment,* freedom from arrest in civil cases for 40 days before and after a meeting of Parliament. Until 1948, peers accused of a felony or of treason had the right to be tried in the House of Lords by their fellow peers.



The United Kingdom nobility wear robes of state on special occasions. The Duke of York, *left,* and the Duke of Kent, *right,* model robes worn by the nobility in the House of Lords.

Dukes, marquesses, and earls have lesser titles besides the one by which they are known. Traditionally, the oldest son of one of these peers uses the highest of his father's lesser titles as a *courtesy title.* For example, the oldest son of the Duke of St. Albans uses the courtesy title Earl of Burford, but he is not a peer. A younger son of a duke adds *Lord* to his name, as in Lord Peter Grey. His sister would be Lady Helen Grey.

The creation of peerages. The British monarch now grants peerages on the recommendation of the prime minister. The monarch issues documents called *letters patent,* which create the new peerage and specify how it will be inherited. In almost all cases, a peer's title passes to his oldest son. If he has no son, it usually goes to his closest male relative. The other children of a peer are commoners, and the title becomes extinct if there is no male heir.

Some medieval peerages were created by royal orders called *writs of summons.* Such peerages may pass to a daughter if the holder leaves no male descendant. If the daughter then has a son, he usually inherits the title.

The last hereditary peerage was created in 1964. Each year, however, the United Kingdom monarch may grant titles called *life peerages* to distinguished persons. A life peerage involves the same privileges as a hereditary peerage, but it does not descend to the holder's children. Life peerages may be awarded to both men and women, and the title given is baron or baroness. Today, there are over 1,000 peers, including more than 600 hereditary peers, 300 life peers, and judges and bishops of the church of England. Most of these peers rarely attend Parliament.

In other countries

In most other countries, titles of nobility have been officially abolished. A person who inherits a title may use it as part of his or her name. But the individual has none of the privileges of the former nobility. Titles of nobility were abolished in France in 1871, in Russia in 1917, in Germany in 1918, and in Japan—except those of the imperial family—in 1946. The titles were often abolished as part of a revolution or a major social and political effort to modernize the country.

Related articles in *World Book* include:

Baron
Burke's Peerage
Count
Duke
Earl
Heraldry
House of Lords
Lady
Lord
Marquess
Viscount

Noble gas refers to any of a group of six chemical elements. These elements are argon (Ar), helium (He), krypton (Kr), neon (Ne), radon (Rn), and xenon (Xe). They occur naturally and can be found in the atmosphere. The British scientists Lord Rayleigh and William Ramsay discovered the noble gases in the late 1890's.

Unlike most gaseous elements, the noble gases are *monatomic*—that is, they occur as single atoms instead of as molecules of two or more atoms. The atoms have stable *configurations* (arrangements) of electrons. Therefore, the atoms do not, under normal conditions, gain or lose electrons or share electrons with other elements. The six gases are called "noble" because they do not readily react with other elements. They are also sometimes called *inert gases* for this reason. However, krypton, radon, and xenon do combine with fluorine and oxygen to form compounds.

The noble gases have various uses. Except for radon, which is highly radioactive, all of them are used as light sources in incandescent, and gaseous-discharge lamps (see **Electric light**). Some also are used in devices called *gas lasers* (see **Laser** [Kinds of lasers]).

Argon and helium are used in a welding process called *arc welding.* They provide a chemically inactive atmosphere in which certain metals, such as aluminium and magnesium, can be heated to their melting points without reacting chemically. Helium also is used in balloons that carry scientific instruments high into the earth's atmosphere, and in low-temperature research. Doctors sometimes use radon—because of its radioactivity—in treating cancer. Each noble gas has a separate article in *World Book.*

Nocturnal animals are animals that are most active during the hours of darkness and least active in daylight. Nearly all animals possess a natural rhythm that governs their behaviour during the day and at night. Nocturnal animals evolved their behaviour as a means of survival. Small creatures can avoid their enemies more readily at night. Desert animals can avoid the heat of the day.

Examples of nocturnal mammals include members of the cat family such as jaguar and lion, cuscuses, *galagos* (bush babies), lemurs, lorises, possums, and tarsiers. Nocturnal birds include owls, frogmouths and nightjars.

Noël. See **Christmas.**

Noel-Baker, Lord (1889-1982), Baron Noel-Baker of Derby, won the 1959 Nobel Peace Prize for his work in promoting international disarmament. He served at the 1919 Paris peace conference and the 1932 Geneva disarmament conference, and helped draft the United Nations Charter in 1945. Noel-Baker entered Parliament in 1924. He held posts in the Labour government of 1945 to 1951. He became a peer in 1977. Philip John Baker was born in London.

Noguchi, Isamu (1904-1988), was an American sculptor whose work represents a wide variety of styles. Noguchi said that he is "suspicious of the whole business of style—again it is a form of inhibition."

Noguchi worked in nearly every sculptural material, avoiding such processes as casting, welding, or painting. Almost all his work has no recognizable subject matter. Noguchi sought to preserve the nature of the sculptural material. He was intrigued by problems of weight, mass, and tension, which he used as themes.

Noguchi was born in Los Angeles of an American mother and a well-known Japanese poet and scholar. He lived in Japan from the age of 2 until he was 13. Noguchi gave up medical studies at Columbia University to return to sculpture, his earlier ambition. In the late 1920's, he studied in Paris with Constantin Brancusi, who had a strong influence on his work. Noguchi designed furniture and settings for ballets. He also collaborated with architects in planning gardens, playgrounds, and bridges.

Noise is random or unwanted sound. Unwanted signals, such as static that interferes with radio transmission, are also referred to as noise. The sound we hear is caused by vibrations of air molecules. A tuning fork produces an almost *pure tone,* with only one *frequency,* or rate of vibration (see **Tone**). Musical instruments produce *harmonic sound.* Such sound contains many fre-

Isamu Noguchi's sculptures typically portray abstract forms in arrangements of smooth, highly polished stone.

quencies, called *overtones,* that are harmonically related (see **Harmonics**). *Random sound* has many overtones that are not harmonically related. Mechanical devices produce such sound.

Unwanted sound can be caused by any kind of sound— tones, harmonic sound, or random sound. Sound is unwanted if it is annoying or distracting, or if it damages the hearing mechanism. People exposed to a loud noise for a long time may suffer temporary or permanent loss of hearing. Workers continually exposed to loud noises may wear earplugs, earmuffs, or special helmets. Noise can also be controlled by using heavy walls and tight doors to block its passage, or by using sound-absorptive materials to reduce its intensity. *Unwanted signals* can mean anything that interferes with or masks the desired signal.

See also **Acoustics; Decibel; Silencer; Sound.**

Noise pollution. See **Sound** (Controlling sound); **Environmental pollution** (Other kinds of pollution); **Airport.**

Nok was a West African civilization that flourished from about 500 B.C. until at least A.D. 200. It was centred in the valley where the Niger and Benue rivers meet. Today, Nok is the name of a village in Nigeria, about 160 kilometres northeast of Baro.

The people of ancient Nok produced the oldest sculptures found so far in black Africa. These sculptures of animal and human figures were identified by the British archaeologist Bernard Fagg, who named them after the village of Nok. Similar sculptures have been discovered at many other sites in the river valley.

The Nok sculptures are made of terracotta, a kind of earthenware. They vary in size from 2.5 centimetres high to life size. All the human heads have pierced ears, and the eyes are hollowed out. Scholars do not know what function these sculptures had in the Nok society. Some believe that the sculpture of other West African peoples shows Nok influence.

The people of Nok probably farmed the land, but they also hunted and gathered food. They made tools and weapons of stone and at least started to learn to smelt and use iron. They probably wore beaded jewellery, including anklets, bracelets, and heavy collars. The Nok people apparently lived in clay huts in the lowlands and hills. Like some Nigerians today, they worshipped their ancestors and had many gods. Little is known about the end of the Nok culture.

Nolan, Sir Sidney (1917-1992), a distinguished Australian painter, was best known for his series of paintings of the bushranger Ned Kelly. Nolan began the Kelly paintings in the 1940's. Earlier artists had tried this theme, but none had managed to make it work. Nolan succeeded in a fascinating way. He presented the episodes in Kelly's life in a series of flat paintings set in the familiar Heidelberg School colours of blue and gold, greatly enlivened by the reds and blues of police and other uniforms. Never before had an Australian legend been presented in such a remarkable way. Other Nolan themes included the cratered landscape of Australia's dead heart, Leda and the swan, Africa, Gallipoli, Antarctica, and China.

Sidney Nolan was born in Melbourne. He trained at the National Art Gallery School in Victoria. He was knighted in 1981.

Nomad is a person who moves from one place to another as a way of making a living. The word *nomad* comes from a Greek word that means *one who wanders for pasture.* Most nomadic peoples move through a certain area according to a cycle based on their activities and the seasons. Nomadic peoples traditionally travel by animal or canoe or on foot. Today, however, some nomads travel by motor vehicle.

Nomads keep moving for different reasons. For example, *hunting and gathering nomads* move in search of game, edible vegetation, and water. The African Pygmies, Australian Aborigines, and Negritos of Southeast Asia camp in different places to hunt animals and gather wild plants. Some American Indians followed this way of life. *Pastoral nomads* travel to find water and pastures for their herds. Bedouin herders move their camels, sheep, and goats through the deserts of Arabia and northern Africa. The Fulani and their cattle travel through the grasslands of Niger in western Africa. *Nomadic craftworkers* and *merchants,* such as the Lohar blacksmiths of India and the Gypsy traders, travel to serve their customers. Nomadic peoples, especially herders, may also move to attack settled communities.

Most nomads travel in groups of families called bands or tribes. These groups are based on kinship and marriage ties or on formal agreements of cooperation.

Related articles in ***World Book*** include:

Africa (Ways of life in northern Africa)
Agriculture (Nomadic herding)
Arabs (Life in the Arab world)
Asia (Way of life in Southwest Asia)
Bedouins
Gypsies
Kenya (Way of life)
Mongolia (People)
Sahara (People)
Somalia (People)
Sudan (People)
Tuareg

Nominative case. See **Case.**

Nonaggression pact is a treaty by which two or more nations agree to settle mutual disputes by peaceful means and not to attack each other. Between World War I (1914-1918) and World War II (1939-1945), many nations signed nonaggression pacts because there was no international force strong enough to prevent aggression.

Nonaggression pacts sometimes were not effective because they lacked enforcement procedures, and also because participating nations violated their agreements. For example, during the 1920's and 1930's, the Soviet Union signed pacts with many of its neighbours. But the Soviet Union violated its agreements with Estonia, Latvia, and Lithuania when it occupied them in 1939 and 1940. These nations regained their independence in 1991 when the Soviet Union broke up. Germany signed a nonaggression pact with the Soviet Union in 1939, but attacked the Soviets in 1941.

Since the end of World War II, there have been fewer attempts to establish nonaggression pacts. Many nations feel that the United Nations charter contains adequate provisions for the peaceful settlement of disputes.

A major problem with nonaggression pacts is to decide an acceptable definition of *aggression.* The UN has not agreed on a definition. Some nations believe aggression includes only direct military attacks. Others feel that when one country aids revolution in another through propaganda, subversion, or by taking over government posts, it constitutes indirect aggression.

See also **League of Nations; United Nations.**

Nonaligned nation. See Third World.

Nonballistic missile. See Guided missile (Nonballistic missiles).

Nonfiction. See Literature (Nonfiction); Writing (Nonfiction); Literature for children (Children's nonfiction).

Nonmetal. See Metal.

Nonverbal behaviour. See Kinesics.

Nonviolent resistance. See King, Martin Luther, Jr.; Gandhi, Mohandas Karamchand.

Noon. See Day; Time.

Noonan, Michael J. (1935-), was minister for the Republic of Ireland's Department of the Marine from 1989 to 1992. He had been Minister of Defence from 1987 to 1989. A Fianna Fáil politician, he has represented Limerick West in Dáil Éireann since 1969. From 1983 to 1987, he was opposition spokesman on agriculture. Noonan was born in Bruff, County Limerick. He was educated at Salesian College, Pallaskenry, County Limerick, and at University College, Cork.

Nopal. See Prickly pear.

Nordenskjöld, Nils Adolf Erik (1832-1901), Baron Nordenskjöld, was a Swedish polar explorer, mineralogist, and map authority. In 1878 and 1879, he became the first person to sail through the Northeast Passage between the Atlantic and Pacific oceans. He sailed along the northern coast of Europe and Asia. He tells of this journey in his book, *Voyage of the Vega* (1881).

Nordenskjöld was born in Helsinki, Finland. He moved to Sweden in 1857, and became a Swedish citizen. He led two expeditions in an attempt to reach the North Pole. On the first one in 1868, he took his ship, the *Sofia,* to within about 925 kilometres of the Pole. Nordenskjöld studied the geology of Greenland in 1870. He returned in 1883, and penetrated the ice barrier off the east coast. He travelled far enough over the inland ice to determine that it covered the interior of the island.

Nordhoff and Hall were a team of American authors. Charles Bernard Nordhoff (1887-1947) and James Norman Hall (1887-1951) became famous for their three novels about an actual mutiny in the British Navy in 1789. These novels are *Mutiny on the Bounty* (1932), *Men Against the Sea* (1934), and *Pitcairn's Island* (1934). The first novel describes how the crew of the Bounty mutinied against their cruel captain, William Bligh. The second novel tells about the hardships of Bligh and his followers after they were set adrift in a small boat. The final novel follows the lives of the crew and their descendants after they settled on Pitcairn Island and Norfolk Island in the South Pacific Ocean.

Nordhoff was born in London, and Hall was born in Colfax, Iowa, U.S.A. They met while serving as pilots in the *Lafayette Escadrille,* a French and American air squadron, during World War I (1914-1918). In 1920, Nordhoff and Hall sailed for Tahiti, where they lived for many years. The men wrote several novels together as well as a number of works individually.

See also Bligh, William; Pitcairn Island.

Nore is a river in the Republic of Ireland. It rises in Devilsbit range, in Tipperary, and flows southeastwards for 110 kilometres. It is joined by the Barrow and the Suir rivers before reaching the sea at Waterford Harbour.

Norfolk in England is the county of the Broads, the long, reedy waterways and lakes visited by thousands of holiday-makers and sailing enthusiasts every year. Norfolk has many windmills, magnificent churches, and cottages built of flint. The Fens, a distinctive feature of Norfolk's topography, is an area of low, marshy land. Norfolk is mainly a farming county. Its farmers in the 1700's were among the first to use new farming methods, such as crop rotation.

In 1974, when England's local government was reorganized, Norfolk was almost unaffected. Great Yarmouth and Norwich, which had been separately administered as county boroughs, became part of the county for administration.

People and government

Local customs and legends. The ancient fair at King's Lynn, the Lynn Mart, was first held 800 years ago. Norfolk's legends include the story of the *Swaffham Tinker.* John Chapman, a pedlar in medieval times, dreamt that if he went to London he would find wealth. In London, Chapman met a man who had had a dream of gold buried under a tree in Swaffham. Chapman hurried to Swaffham and found the gold. With his fortune, Chapman paid all the costs connected with the building of the north aisle of Swaffham church.

Recreation. Sailing and angling are both popular pastimes. Members of wildfowling clubs shoot ducks and geese along the salt marshes and mud flats. However, the county has a number of nature reserves. The heathland is ideal for horse-riding. There are packs of foxhounds, harriers and other hounds. Snettisham has a motor-racing circuit. Norwich's football team plays in the Football League.

The county's cultural events include King's Lynn Festival of Music and Arts. The festival, held in July, attracts musicians from many countries.

Local government. Norfolk is divided into seven local government districts: *Breckland,* which includes Thetford; *Broadland,* which includes Aylsham; *Great Yarmouth; King's Lynn and West Norfolk,* which also includes Downham Market; *North Norfolk,* which includes North Walsham; *Norwich; South Norfolk,* which

Norfolk lies on the eastern coast of England, bordered to the east and north by the North Sea and the Wash.

The Norfolk Broads make up a vast area of interconnecting lakes and waterways. The Broads attract a large number of boating and fishing enthusiasts.

includes Wymondham. The crown court meets at King's Lynn and Norwich. The police force is the Norfolk Constabulary, with headquarters at Norwich.

Economy

Agriculture. Norfolk is one of England's most important cereal-growing counties, producing much barley, oats, rye, and wheat. Sugar beet is an important crop, and there are beet-processing factories at Cantley, King's Lynn, and Wissington. Farmers supply much fruit and vegetables to canning or freezing factories. Attleborough has an old-established cider factory. Livestock in Norfolk include sheep and both beef and dairy cattle. Farmers in many parts of the county keep poultry, especially turkeys and ducks.

Fishing. The Wash has an important fishing industry based in King's Lynn. It produces cockles, mussels, and shrimps. Cromer and Sheringham market local crabs and lobsters. Brancaster produces mussels, and Stiffkey is famous for cockles.

Manufacturing. In recent years, light industries have moved into former market towns such as East Dereham and Thetford. East Dereham's factories turn out such varied products as electric clocks, furniture, toys, and motor vehicle parts. Four industrial estates at Thetford produce caravans, clothing, food products, and scientific instruments.

King's Lynn has food-processing industries and factories producing freezers and refrigerators, furniture, glass, pencils, and various kinds of heavy and light engineering products. Manufacturers at Norwich produce boots and shoes, clothing, and pharmaceutical products. Great Yarmouth is a base for companies drilling for gas or oil in the North Sea.

Tourism. Many people near the coast depend on tourism for their income. The leading resort is Great Yarmouth. There are a number of other resorts.

Transport and communications. Main railway lines link London with King's Lynn and with Norwich. These two main lines are linked by a branch line from Norwich to Ely, in Cambridgeshire.

Most main roads radiate from Norwich, including an east-west route from Great Yarmouth to King's Lynn. Main roads include the A10 and the A11 from London.

Two daily newspapers are published in Norwich, which also has the studios of an independent television company, a BBC local radio station, and an independent local radio station, Radio Broadland. The county has many weekly newspapers.

Land

Location and size. The Wash estuary and the North Sea mark the northern and eastern boundaries of the county. The Waveney and Little Ouse rivers separate Norfolk from Suffolk in the south. The Little Ouse and the Nene divide it from Cambridgeshire and Lincolnshire in the west.

Land features. Much of Norfolk is flat. Some of the land is below sea level. Western Norfolk is a region of fenland. But the northern part of the county has hills. Marshland, a region lying mainly west of the Great Ouse, in western Norfolk, is part of the Fens.

Northern Norfolk, a hilly area, extends from The Wash along the coast to Cromer and Mundesley. Cliffs line the coast at Hunstanton, Sheringham, and Cromer. Wide salt marshes, formed by the estuaries of such streams as the Stiffkey, cover the central area.

The banks of the Rivers Nar, Tas, Wensum, Wissey, and Yare are well wooded. Pine forests grow on the sandy heathlands of the Breckland region.

Lakes and rivers. There are *meres* (lakes) at Ring Mere and Langmere in Breckland. The Broads are a se-

Facts in brief about Norfolk

Administrative centre: Norwich.
Largest towns: Norwich, Great Yarmouth, King's Lynn.
Area: 5,355 square kilometres.
Population: *1991 census*—736,700.
Chief products: *Agriculture*—barley, beef and dairy cattle, ducks, fruit, oats, rye, sheep, sugar beet, turkeys, vegetables, wheat. *Manufacturing and processing*—boots and shoes, caravans, cider, clothing, electric clocks, engineering goods, food products, freezers and refrigerators, furniture, scientific instruments, toys, vehicle parts.

Places to visit

Following are brief descriptions of some of Norfolk's interesting places to visit:

Blickling Hall, near Aylsham, is a splendid Jacobean house designed by Robert Lyminge. It has many portraits and rare manuscripts.

Bressingham Steam Museum, near Diss, has steam locomotives and fairground roundabouts.

Castle Acre, north of Swaffham, has ruins of a priory founded in 1090.

Castle Rising has a Norman castle built in the 1100's. Trinity Hospital is an almshouse built about 1614. Its residents traditionally wear red cloaks and black hats on Sundays.

Great Witchingham, near Bawdeswell, has a wildlife park with a collection of European birds and animals. Its aim is to save species from extinction.

Great Yarmouth has a Maritime Museum displaying shipping and marine and life-saving equipment.

Grimes Graves, near Weeting, are flint-mines dug 4,000 years ago, during the New Stone Age.

King's Lynn has a Guildhall, built in 1421. The Customs House was built in 1683.

Norfolk Broads are large stretches of water, lying in holes cut by medieval peat-diggers. They have 320 kilometres of navigable waterways, nature reserves, and scenery.

Norwich has a cathedral begun in 1096. Its bishop's throne is probably England's oldest. The Norman castle houses a museum and an art gallery that features paintings of the Norwich School.

ries of lakes and marshes. Hickling Broad is the largest lake. The rivers Yare and Bure link the Broads and reach the sea through the tidal estuary Breydon Water. Other rivers include the Nar, Nene, Ouse, Tas, Thet, Waveney, Wensum, and Wissey.

Climate is dry, with an average rainfall of about 600 millimetres a year. Temperatures in January average 4° C. In July, they average 17° C. Winds blow mostly from the east.

History

Prehistoric flint-mines at Grimes Graves near Brandon show that human beings have lived in Norfolk for thousands of years. The ruins of the Roman town of Venta Icenorum are at Caistor St. Edmund, near Norwich.

Norfolk is part of the area known as *East Anglia* because it was once occupied by the Angles. Its peoples were the *north folk* of Anglia, as distinct from the *south folk* who lived further south. The town of Thetford was once the capital of East Anglia. People who farmed in the Broadland area in the early Middle Ages dug peat for fuel. High tides and floods from the North Sea in the 1300's created the Broads.

Norfolk has many connections with America. John Rolfe (1585-1622) left Heacham to go to Virginia, where he married Pocahontas, the daughter of an American Indian chief. The ancestors of the American president Abraham Lincoln lived in Hingham, near Wymondham. The philosopher Thomas Paine was born in Thetford. Other famous people associated with Norfolk include Sir Robert Walpole and Lord Nelson.

Norfolk, Virginia (pop. 261,229; met. area pop. 1,396,107), is a leading United States port. It is situated in southeastern Virginia at the entrance to Chesapeake Bay.

Hampton Roads, one of the world's finest natural deepwater harbours, forms Norfolk's northwestern boundary. The Norfolk Naval Base on Hampton Roads is the largest naval installation in the United States. It also serves as headquarters of the Atlantic Command of the North Atlantic Treaty Organization (NATO).

In 1680, the Virginia General Assembly founded a port in Norfolk County to serve ships sailing to and from England and the West Indies. The port was later named Norfolk after the county. It became an independent borough in 1736 and an independent city in 1845.

The economy of Norfolk depends heavily on Hampton Roads. The Norfolk Naval Base, the city's largest employer, lies on the shore of Hampton Roads. About 22,000 civilians work at the base. Hampton Roads, which includes Norfolk and other ports, handles more coal than any other port district in the world. It serves as the distribution centre for the rich coal-mining regions of southwestern Virginia and West Virginia. The port of Norfolk handles about 43 million metric tons of cargo a year.

The Norfolk metropolitan area has about 650 manufacturing companies. Their chief products include processed foods, ships, and trucks.

Norfolk has a council-manager form of government. The voters elect seven councilmen to four-year terms. The councilmen choose one of their group as mayor and hire a city manager to carry out their policies.

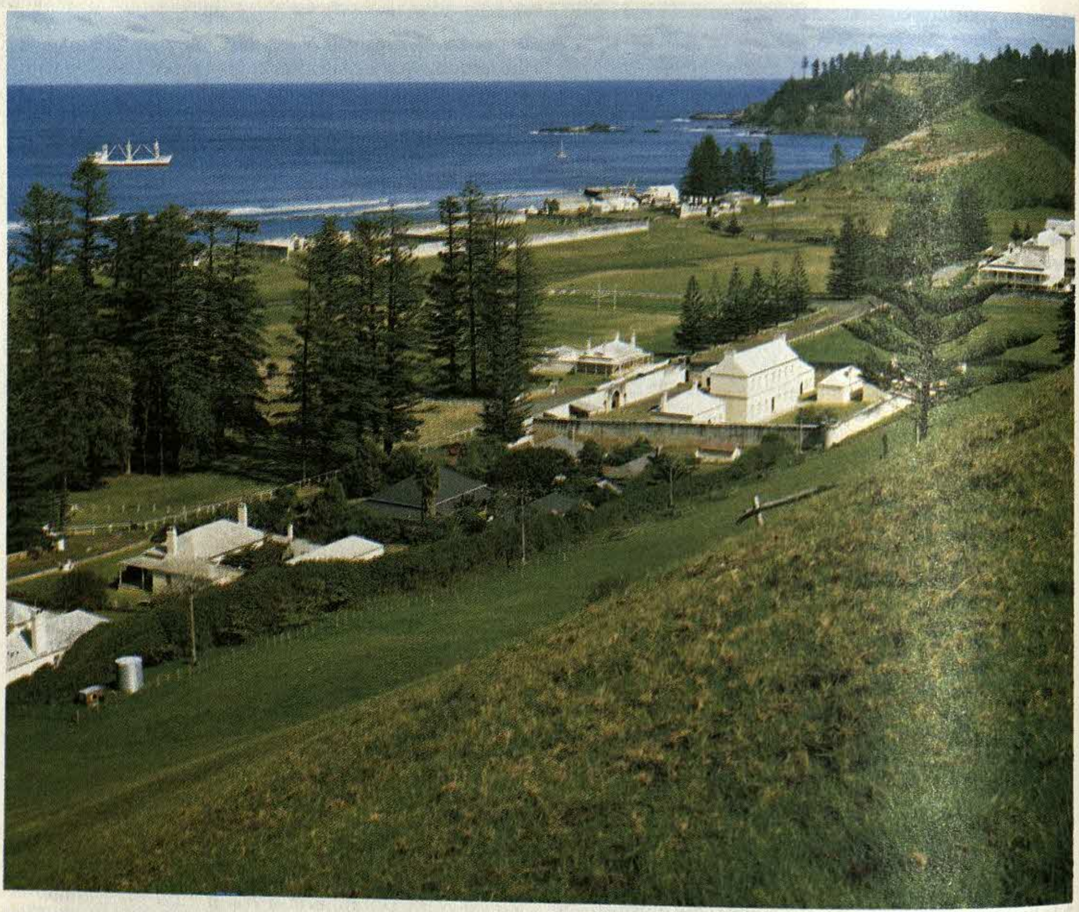
Powhatan Indians lived in what is now the Norfolk area when white men first explored there in the early 1600's. Early Norfolk served as a colonial tobacco and naval supply port. In 1776, during the American Revolution, a British fleet bombarded and destroyed much of the town. Norfolk was incorporated as a city in 1845.

Norfolk grew slowly until the Navy began to build the naval base in 1917, shortly after the nation entered World War I. During World War II (1939-1945), thousands of civilians moved to the city to work in the navy yards and on the base. The population of Norfolk rose from 144,332 in 1940 to 213,513 in 1950.

In 1951, the city began an urban renewal programme. This project included slum clearance and the construction of public housing. During the 1970's, the city constructed several high-rise buildings and a waterfront hotel. In 1983, Waterside, a festival marketplace, was completed on the waterfront.

Norfolk Island is an Australian territory in the southern Pacific Ocean, over 1,600 kilometres northeast of Sydney and over 1,000 kilometres northwest of Auckland, New Zealand. The territory consists of the main island—Norfolk Island—and two small, uninhabited islands—Philip and Nepean islands. It has an administrator appointed by Australia's governor-general. The administrator is responsible to the Australian government through the Department of Territories in Canberra. The Norfolk Island Legislative Assembly has power to make laws that concern a wide range of matters. There is no income tax on Norfolk Island, but there is a small levy to cover the cost of public works.

Norfolk Island is only about 8 kilometres long and 5 kilometres wide. It has steep cliffs and no harbours or anchorages. Ships stand off the island and unload into lighters. Norfolk Island is hilly and has two prominent peaks, Mount Pitt and Mount Bates, both about 300 metres above sea level. They are easily climbed and afford



Norfolk Island has many relics of the time when the island was a convict colony. The officers lived in the street known as *Quality Row, above.*

glorious views of the whole island. In the distance, climbers can see Philip and Nepean islands. Norfolk Island has many streams, and luxuriant vegetation covers the hills and valleys. The towering Norfolk Island pines, which grow in every part of the island, are its most prominent feature.

Many Norfolk Islanders are descendants of the mutineers of the British naval ship *Bounty* and their Tahitian wives. Their ancestors moved west from Pitcairn Island to Norfolk Island. Later, settlers came mainly from Australia and New Zealand. The island has a population of about 2,000. Tourism is the main industry. Kingston is the seat of government.

James Cook landed on Norfolk Island in 1774, during his second voyage around the world, and claimed the island for Britain (now called the United Kingdom). A few weeks after the First Fleet arrived at Botany Bay, in 1788, a small detachment was sent to Norfolk Island to prevent its occupation by any other power. The party, including 15 convicts, landed on March 6, 1788, which is commemorated on Norfolk Island as Foundation Day. After many difficulties, the settlement was abandoned in 1813 and remained uninhabited for the next 12 years.

In June 1825, a second and extremely harsh penal settlement was established on the island. The party consisted of convicts from Botany Bay who had been convicted of committing further crimes while in Australia. Some people in Australia protested against this "Pacific hell." Eventually, the Norfolk settlement was abandoned. The last of the convicts left in 1856.

That same year, 194 people from Pitcairn Island arrived on Norfolk Island to start a new life. Many of them were descendants of the mutineers of H.M.S. *Bounty.* Within a few years, some of the families returned to Pitcairn because of homesickness. In 1896, Norfolk was made a dependency of New South Wales, and in 1914 it became a territory of Australia.

Norfolk terrier is a breed of dog that originated in the United Kingdom. Norfolk terriers and Norwich terriers were considered to be the same breed until 1964. That year, the Kennel Club in England registered them as separate breeds. The two breeds differ only in the way they carry their ears. Norfolk terriers have ears that bend forward, and Norwich terriers have upright ears.

The Norfolk terrier is a hardy, active dog. It is good at hunting rats and rabbits. English fox hunters prize it for its ability to chase foxes out of holes. Norfolk terriers make fine pets because they are affectionate.

The Norfolk terrier may be red, black and tan, wheat-coloured, or grey. It has a straight, wiry outer coat and a heavy undercoat. The fur is extremely thick at the neck and shoulders but short and smooth on the face. The dog has short legs and a tail of medium length. A full-grown Norfolk terrier weighs about 5.4 kilograms and stands about 25 centimetres high.

See also **Norwich terrier.**

Norgay, Tenzing. See **Mount Everest.**

Norheim, Sondre. See **Skiing** (The development of modern skiing).

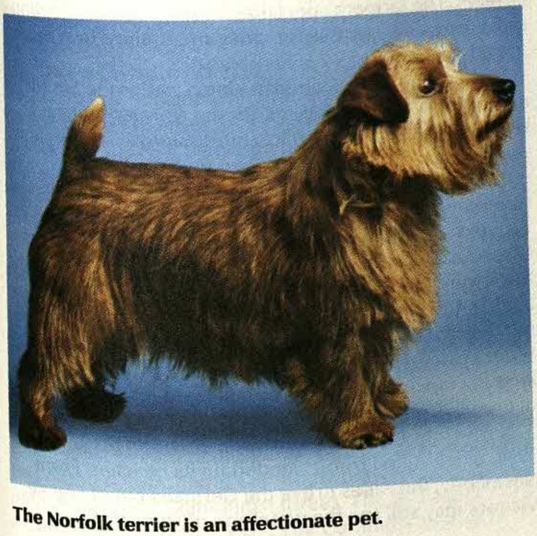
Noriega, Manuel Antonio, (1934-), was a military leader who controlled Panama from 1983 to 1989. In December 1989, United States President George Bush ordered troops into Panama. Bush said the troops were sent in response to the killing of a U.S. marine lieutenant by Panamanian soldiers and charges of drug trafficking against Noriega. In January 1990, Noriega surrendered to U.S. officials and was taken to the United States to stand trial.

Manuel Noriega

Noriega was born in Panama City. He graduated from a military academy in Peru in 1962. That same year, Noriega enlisted in Panama's military, which soon made him a lieutenant. Following a military take-over of the government in 1968, he quickly rose through the ranks. Noriega became commander of Panama's military intelligence agency in 1970 and expanded his power and influence because of the secret knowledge he possessed.

Noriega took charge of the military in 1983 and became increasingly involved in the drug trade in Latin America. Beginning in 1987, the United States tried to force him to resign. In 1992, Noriega was found guilty by a Miami jury on eight charges of conspiracy to manufacture and distribute cocaine. He was given a 40-year prison sentence.

Normal distribution. See **Statistics** (Probability).



The Norfolk terrier is an affectionate pet.

Norman, Greg (1955-), an Australian golfer known as *The Great White Shark,* won the British Open in 1986 and 1993. He was the third Australian to win the event. In 1986, he won a number of other major tournaments and was ranked number one in the world.

Gregory John Norman was born in Mount Isa, Queensland. He won his first golf victory in 1973, in the Queensland Schoolboys Championships. Norman's first big tournament win was the Westlakes Classic in 1976. Later, he won the Open titles in Hong Kong, France, Scandinavia, Canada, and Australia.

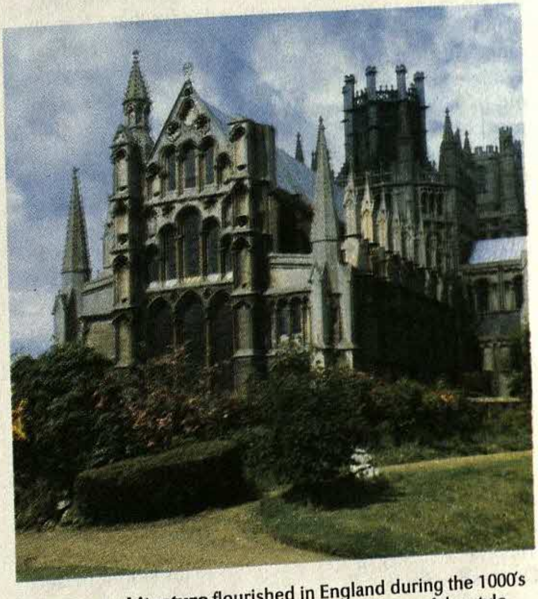
Norman, Lilith (1927-), an Australian author of children's books, won praise for the frank realism of her novels. Her first novel, *Climb a Lonely Hill* (1970), deals with the problems of the children of an alcoholic. Her other novels include *The Shape of Three* (1971), *The Flame Takers* (1973), *Mocking-Bird Man* (1977), *A Dream of Seas* (1978), and *My Simple Little Brother* (1979).

Norman was born and educated in Sydney and trained as a librarian. She became assistant editor of *School Magazine* in 1970.

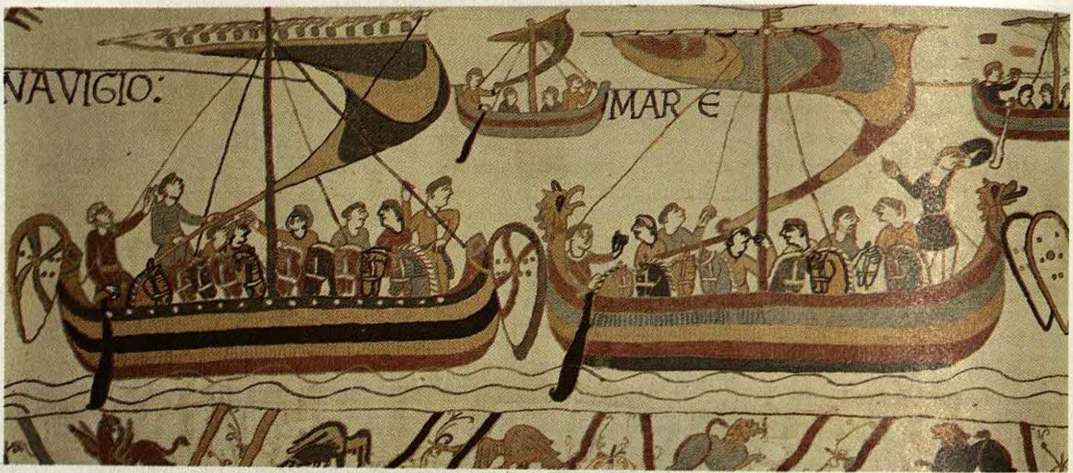
Norman architecture is a regional adaptation of Romanesque architecture. It originated in Normandy in northwest France. The style reached its highest development in England during the late 1000's, after the Norman Conquest of 1066, and in the 1100's. Norman architecture is noted for its massive character, development of the six-part vault ceiling, and the use of Celtic and Carolingian patterns of carved ornamentation. Examples of Norman architecture include the churches of St. Étienne and La Trinité in Caen, France, and Ely and Durham cathedrals in England.

See also **Architecture** (picture: Romanesque architecture).

Norman Conquest is the name given to the conquest of England in 1066 by William, Duke of Normandy. The duke, known as William the Conqueror, led a Norman army across the Channel into England (see **Normans**).



Norman architecture flourished in England during the 1000's and 1100's. Ely Cathedral, *above,* is a masterpiece of the style.



Detail of the Bayeux Tapestry (1000's-1100's), embroidery on linen by unknown artists; Bayeux Museum, Bayeux, France

The Norman Conquest of England began in 1066 when William the Conqueror sailed his army across the Channel.

William was a proud and ruthless ruler and a vassal of the king of France. He hoped to follow his distant cousin, King Edward the Confessor, as king of England. William claimed that Edward had named him as his successor. The chief English contender for the throne was Harold, Earl of Wessex. But William also claimed that Harold, who had visited Normandy in 1064, had sworn a solemn oath to support William's claim to the throne. In 1066, King Edward died. The Anglo-Saxon Witan (Great Council) chose Harold as king (see **Harold** [II]).

William at once declared his right to the throne. He claimed to have the support of the pope and gathered an army from throughout northern France. William landed in England without opposition at Pevensey, near Hastings.

The Normans were aided in their successful landing by a chance happening. While Harold was waiting for the Normans to arrive, he received news that a Norwegian force had landed in the north of England. He hastened north and defeated the Norwegians. Meanwhile, William landed his force on the unprotected coast. Harold then marched back across England. But as he approached Hastings, he was attacked by William on Oct. 14, 1066. This was the historic Battle of Hastings, which established the Norman rule of England. Harold was defeated and slain. William marched on to London and was crowned king of England on Christmas Day, 1066. At first, he tried to win over the English nobles. But they opposed him stubbornly, and he spent several years subduing them.

William established Norman rule in England on a strong foundation. He hesitated at no act which he thought would increase the power of the crown. William took all the land of the English nobility and divided it among his Norman followers. William forced all these landholders to swear loyalty to himself. In this way, he put all the lords of England under his direct control. In order to know conditions in England, the Conqueror directed the preparation of the famous Domesday Book. This was a survey of all the regions in his kingdom (see **Domesday Book**).

The descendants of the Normans became the ruling class in England. For a time, they kept themselves aloof from the Anglo-Saxons and treated them as a conquered people. But as the years went by the Normans and the Anglo-Saxons intermarried. The two peoples, which even in the beginning were similar, blended into one. Today, many English families claim—though few can prove—descent from the Norman conquerors.

The Normans contributed much to the English language and to English literature and architecture. At first, the Normans spoke French. Later, the Norman French blended with the Germanic tongue of the Anglo-Saxons and became English.

See also **England** (The Norman Conquest); **Hastings, Battle of; Ireland, History of; William I, the Conqueror.**

Normandy is a region in northwestern France. It was named after the Norse people who conquered the area in the 800's. It lies along the English Channel coast between the regions of Picardy and Brittany. The famous towns of Normandy include Rouen, the capital of the old province; Le Havre, Honfleur, Caen, Bayeux, and Cherbourg. The inhabitants are well known as sailors and farmers. The farmers specialize in dairying and growing fruits, especially apples for cider and brandy. Iron ore is mined near Caen.

In A.D. 911, the Carolingian king, Charles the Simple, made Normandy a duchy under the Norman chieftain Hrolf, or Rollo. One of Rollo's most famous descendants was William the Conqueror, who won the English crown after the Battle of Hastings in 1066. Events surrounding the battle are portrayed on the famous Bayeux Tapestry, a medieval wallhanging housed in the Bayeux Museum. Normandy was united with England during the reign of the English king, Henry I (1100-1135). England and France struggled for control of Normandy during the Hundred Years' War. The English recovered the region twice, but finally lost it in 1449 to Charles VII, king of France. Joan of Arc became famous as the leader of French troops in the fight for Normandy.

Normandy attracted worldwide attention on June 6, 1944, when Allied troops landed on its beaches. From Normandy, the Allies drove the Germans out of France. Visitors may still see the wreckage of ships that took part in the Allied invasion. Many towns in Normandy were damaged in the fighting, but have been repaired.

See also **Normans; World War II** (D-Day); **France** (terrain map); **Vikings** (The Danish Vikings).

Normandy, Duke of. See **William** (William I, The Conqueror).

Normans were a group of Vikings, or *Norsemen* (Scandinavians), who first settled in northern France, then advanced into England, southern Italy, and Sicily. In the 800's, Norman warriors began their conquests by raiding French coasts and river valleys. By the early 900's, they had settled in the French territory near the mouth of the Seine River that is now known as Normandy. In 911, the Norman chief Hrolf, or Rollo (860?-931?), became a duke in the service of the Frankish king, Charles the Simple. The Normans became Christians and adopted French customs. Many became famous as administrators, church leaders, and crusaders.

Norman power expanded after 950. Norman warriors invaded the Rhineland, an area in present-day Germany. In 1066, under the leadership of William, Duke of Normandy, they conquered England. After the conquest, Norman influence spread steadily throughout Britain and Ireland (see **William** [William I, the Conqueror]). During the same period, Norman groups won great victories in other lands. Robert Guiscard (1015?-1085), son of Tancred of Hauteville, conquered southern Italy. Roger, another of Tancred's sons, took the island of Sicily from the Muslims. These two territories were later united in the famous Kingdom of the Two Sicilies by Roger's son, Roger II. Major advances in architecture and sculpture occurred during the period of Norman domination in western Europe. The spread of an architectural style called *Romanesque* owed much to the Normans.

See also **Norman Conquest; Normandy; Vikings.**

Norns were the three Fates of Scandinavian mythology. They were three sisters: Urd (Past), Verdandi (Present), and Skuld (Future). Urd was old and looked toward the past. Verdandi faced straight ahead into the present. Skuld represented the future, and looked in a direction opposite from that of Urd. The fate of people and gods was decided by the Norns. The early Scandinavians believed that there were many lesser Norns, and one for each person.

Norodom Sihanouk (1922-) is the king of Cambodia. He first became king in 1941, but gave up the throne in 1955 to enter politics. Sihanouk resumed the title of king in 1993, following his return from exile in China. Under the terms of Cambodia's 1993 Constitution, the king serves as "the symbol of national unity and continuity". He has almost no influence in the nation's daily affairs, but enjoys the support of a majority of Cambodia's people.

In the early 1950's, Sihanouk led his country's successful struggle for independence. Sihanouk became premier in 1955 and chief of state in 1960.

In March 1970, while Sihanouk was out of the country, several members of his government overthrew him. Sihanouk went to Beijing, China, and formed a pro-Communist government-in-exile. By the end of 1970, war had erupted throughout Cambodia between government troops and Communist forces. The war ended with a Communist victory in 1975. The Communists, called the Khmer Rouge, gave Sihanouk the title of chief of state, but did not give him any important role in the government. He resigned from this office in 1976.

In 1979, another group of Cambodian Communists, supported by Vietnam, overthrew the Khmer Rouge and took control of the government. In 1982, Sihanouk became head of a coalition of groups that opposed the country's new government (see **Cambodia** (History). In May 1987, he took a leave of absence as president of the coalition.

Sihanouk was born in Phnom Penh.

Norris, Frank (1870-1902), was an American novelist and journalist and a leader of the naturalism movement. Norris believed that a novel should serve a moral purpose. "The novel with a purpose", he explained, "brings the tragedies and griefs of others to notice" and "prove(s) that injustice, crime, and inequality do exist".

Benjamin Franklin Norris, Jr., was born in Chicago. He moved to San Francisco with his family in 1884. While attending the University of California from 1890 to 1894, he came under the influence of the French naturalist writer Émile Zola.

In 1895 and 1896, Norris was a reporter in South America. In 1899, he became a manuscript reader for a publisher in New York City. That year he published *McTeague,* which tells how economic circumstances, alcoholism, heredity, and chance compel a man to become a murderer.

Norris' novel *The Octopus* (1901) dramatizes how a railway controlled a group of California wheat farmers. The book emphasizes the control of "forces", such as wheat and railways, over people. It ranks with *McTeague* as Norris' finest work. *The Pit* was published in 1903, after Norris died at the age of 32 following an operation for appendicitis.

Norse mythology. See **Mythology** (Teutonic mythology).

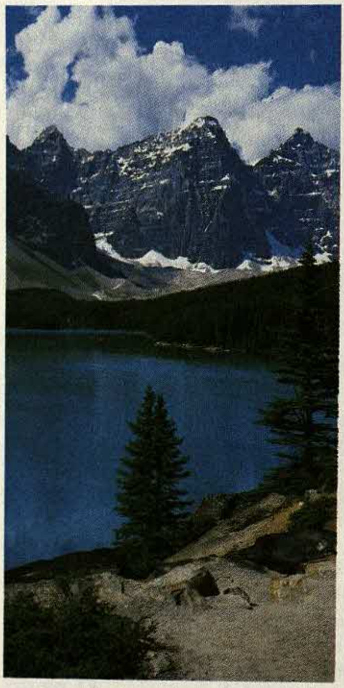
Norsemen. See **Vikings.**

North, Lord (1732-1792), Frederick, Earl of Guilford, was a British prime minister whose shortsighted treatment of the American Colonies helped bring on the American Revolution.

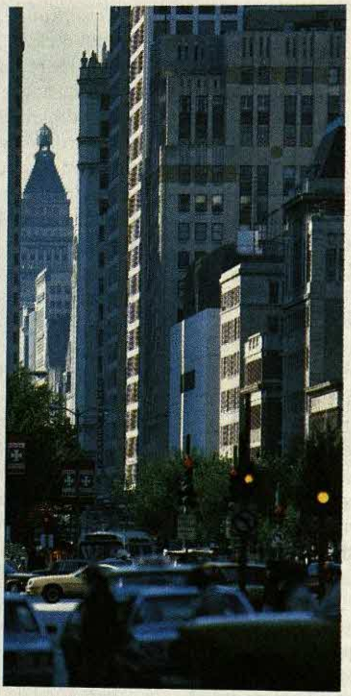
North was closely associated with King George III, and managed the House of Commons in the king's interests (see **George** [III] of England). Even when he disagreed with his master's policy, he did not oppose it. He often asked to resign, but the king would not allow it. North supported the tea tax that became one of the causes of the American Revolution (see **Boston Tea Party**). As the American Revolution progressed, North's administration became increasingly disorganized and demoralized. He finally persuaded the king to accept his resignation in 1782. He became joint secretary of state with Charles Fox in 1783, but resigned after only nine months in office (see **Fox, Charles J.**).

North was born in London, and he attended Eton College and Oxford University. His father had him elected to Parliament in 1754 from a "pocket borough" owned by the family. North later served in the Treasury and as a member of the Privy Council. He became chancellor of the exchequer and leader of the House of Commons in 1767. In 1770, he became prime minister and remained in office for 12 years.

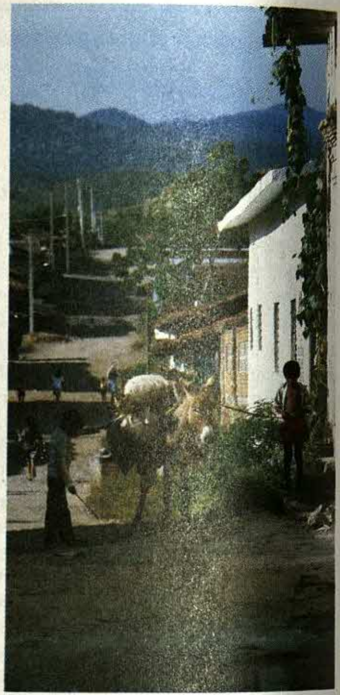
North, Christopher. See **Scottish literature.**



The Canadian Rockies



Chicago city centre



Rural Mexico

North America

North America, the third largest continent in area, extends from the Arctic Ocean in the north to South America in the south. Only Asia and Africa cover larger areas. North America ranks fourth among the continents in population, after Asia, Africa, and Europe.

North America includes Canada, Greenland, the United States, Mexico, Central America, and the islands of the Caribbean Sea. Canada and the United States make up what is sometimes called Anglo-America (English-America) because many of their settlers came from England. English is the dominant language in Anglo-America. Mexico, Central America, and the Caribbean islands are sometimes called Middle America because they lie between Anglo-America and South America. Spanish is the dominant language in Middle America, though English is the only language on many Caribbean islands.

Anglo-America has valuable supplies of coal, petroleum, natural gas, and other underground resources. It has thick forests and vast farmlands. Anglo-America produces about a third of the world's manufactured goods. It also exports more food than any other region in the world. Some Middle American countries, on the other hand, have very few natural resources and only small areas of level farmland.

North America offers other contrasts. Its climate is the most varied of any continent. Northern ice-covered plains differ widely in temperature from sunny Caribbean beaches. The landscape ranges from magnificent mountain peaks to flat grasslands stretching to the horizon. Luxuriant redwood forests along the Pacific coast contrast sharply with the parched sands of the southwestern deserts. North America has the world's largest island, Greenland, and the world's largest freshwater lake, Lake Superior.

People

The earliest North Americans were American Indians (sometimes called Amerinds) who travelled to the continent from Asia. Most scientists think they arrived about 15,000 years ago, but some believe they arrived as early as 35,000 years ago. The Indians crossed the Bering

Facts in brief about North America

Area: 24,227,000 km². *Greatest distances* (mainland)—north-south, 7,200 km; east-west, 6,400 km; (including islands)—north-south, 8,900 km; east-west, 8,900 km. *Coastline*—about 300,000 km.

Population: 458,000,000; density, 19 people per km².

Elevation: *Highest*—Mount McKinley in Alaska, U.S.A., 6,194 m above sea level. *Lowest*—near Badwater, Death Valley, U.S.A., 86 m below sea level.

Physical features: *Chief mountain ranges*—Alaska, Appalachian, Cascade, Coast, Rocky, Sierra Madre, Sierra Nevada. *Chief rivers*—Arkansas, Colorado, Columbia, Fraser, Mackenzie, Mississippi, Missouri, Nelson, Ohio, Rio Grande, St. Lawrence, Yukon. *Chief lakes*—Athabasca, Erie, Great Bear, Great Salt, Great Slave, Huron, Michigan, Nicaragua, Ontario, Superior, Winnipeg. *Chief deserts*—Chihuahuan, Colorado, Great Basin, Mojave, Painted, Sonoran, Vizcaíno, Yumà. *Chief waterfalls*—Niagara, Ribbon, Silver Strand, Takakkaw, Yosemite. *Chief islands*—Cuba, Greenland, Hispaniola, Jamaica, Newfoundland, Puerto Rico, Vancouver.

Number of independent countries: 23.

Strait—which was dry land then—while following the large mammals they hunted. They eventually settled throughout the continent, but especially in Middle America. The ancestors of today's Inuit migrated from Asia to the northern part of North America several thousand years ago.

Europeans began settling the continent in the late 1400's and early 1500's. Explorers from Spain were the first to sail across the Atlantic Ocean to Middle America. About 100 years later, British and French people settled in what are now the United States and Canada. Blacks from Africa were originally brought to North America by the Spanish to work as slaves on sugar plantations in the Caribbean. Black slaves were later brought to Atlantic coastal areas of the mainland.

Population. About 8 per cent of the world's population live in North America. For North America's total population, see the *Facts in brief* table with this article. Few people live in the cold northern part of the continent or in its western deserts. Many large cities lie along the eastern Great Lakes, the St. Lawrence River, and the Atlantic coast from Massachusetts to Virginia, U.S.A. Since the 1950's, many people have moved from the Northeastern and Midwestern United States to California and states in the Southwest and along the Gulf coast. In Middle America, most people live in the cool highlands where the Indians originally settled. Mexico City, located in these highlands, is one of the world's largest metropolitan areas. Since 1900, many Mexicans, Puerto Ricans, and Cubans have settled in the United States.

Ancestry. Most North Americans are descendants of Europeans. Immigrants from every European country have settled in North America. More than a third of the people of the United States and nearly half of the people of Canada have ancestors from the British Isles. More than a quarter of all Canadians have French ancestors. Most European ancestors of Middle Americans came from Spain.

Independent countries of North America

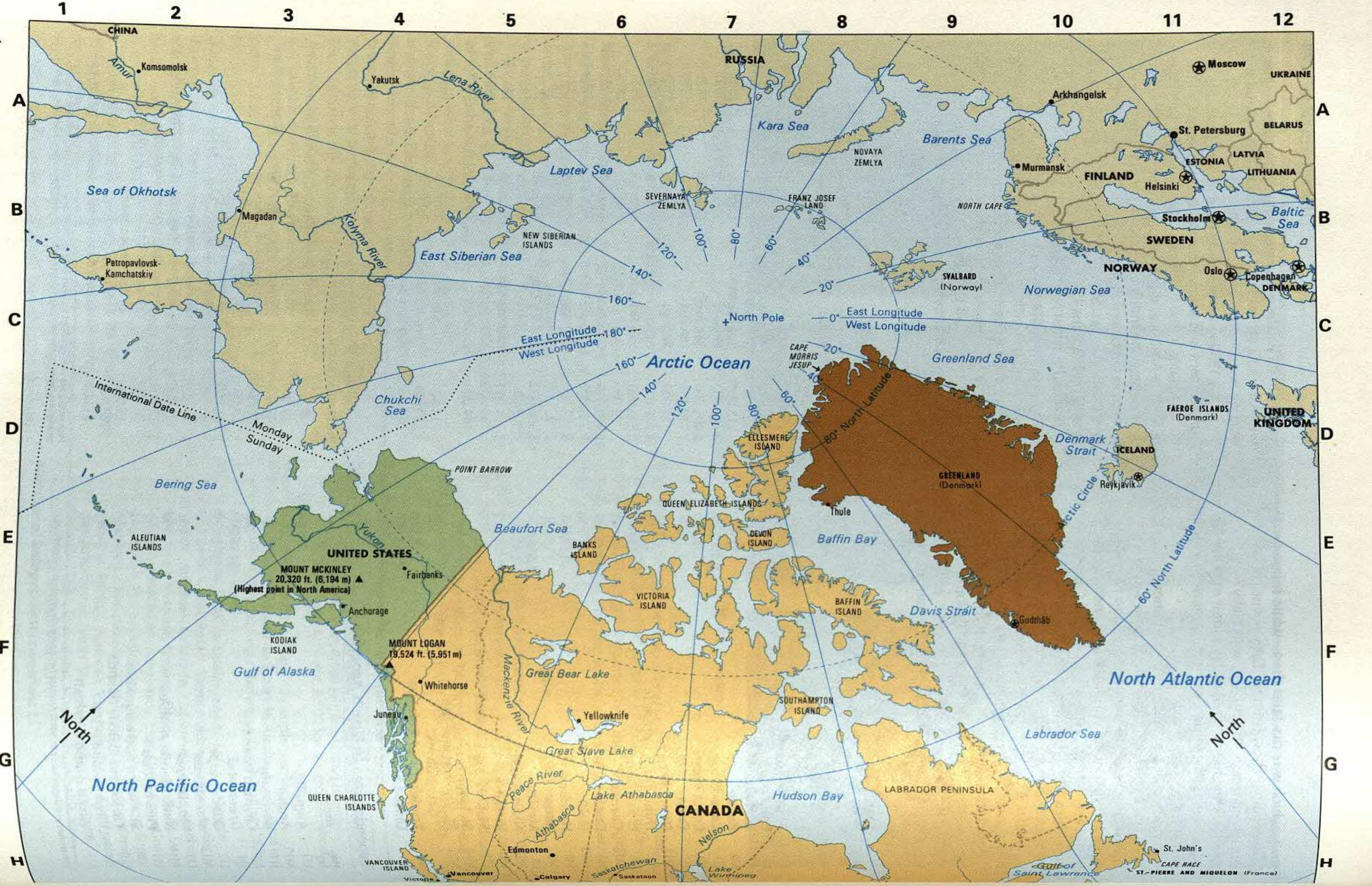
Map key	Name	Area In km²	Population	Capital	Official language	Date of independence
L12	**Antigua and Barbuda**	442	69,000	St. John's	English	1981
L9	**Bahamas**	13,878	281,000	Nassau	English	1973
M12	**Barbados**	430	262,000	Bridgetown	English	1966
M8	**Belize**	22,965	213,000	Belmopan	English	1981
G7	**Canada**	9,970,610	28,902,000	Ottawa	English; French	1931
N9	**Costa Rica**	51,100	3,495,000	San José	Spanish	1821
L9	**Cuba**	110,861	11,172,000	Havana	Spanish	1898
M12	**Dominica**	751	71,000	Roseau	English	1978
L10	**Dominican Republic**	48,734	8,050,000	Santo Domingo	Spanish	1844
N8	**El Salvador**	21,041	5,893,000	San Salvador	Spanish	1821
M12	**Grenada**	344	92,000	Saint George's	English	1974
M8	**Guatemala**	108,889	10,919,000	Guatemala City	Spanish	1821
M10	**Haiti**	27,750	7,328,000	Port-au-Prince	French	1804
M8	**Honduras**	112,088	6,132,000	Tegucigalpa	Spanish	1821
M9	**Jamaica**	10,990	2,575,000	Kingston	English	1962
L6	**Mexico**	1,958,201	95,365,000	Mexico City	Spanish	1821
N8	**Nicaragua**	130,000	4,569,000	Managua	Spanish	1821
N9	**Panama**	78,200	2,704,000	Panama City	Spanish	1903
L11	**St. Christopher and Nevis**	261	44,000	Basseterre	English	1983
M12	**St. Lucia**	622	144,000	Castries	English	1979
M12	**St. Vincent and the Grenadines**	388	113,000	Kingstown	English	1979
M12	**Trinidad and Tobago**	5,130	1,317,000	Port-of-Spain	English	1962
J7	**United States**	9,363,563	264,015,000	Washington, D.C.	English	1776

Dependencies in North America

Map key	Name	Area In km²	Population	Status
L11	**Anguilla**	96	7,000	British dependency; some self-government
M10	**Aruba**	193	59,000	Self-governing part of the Netherlands
J11	**Bermuda**	54	58,000	British dependency; some self-government
M9	**Cayman Islands**	259	30,000	British dependency
D9	**Greenland**	2,175,600	58,000	Province of Denmark
L12	**Guadeloupe**	1,704	345,000	Overseas department of France
M12	**Martinique**	1,100	360,000	Overseas department of France
L11	**Montserrat**	102	13,000	British dependency
M11	**Netherlands Antilles**	798	185,000	Self-governing part of the Netherlands
L11	**Puerto Rico**	9,103	3,522,000	United States commonwealth
H11	**St.-Pierre and Miquelon**	242	6,000	Overseas department of France
L10	**Turks and Caicos Islands**	430	13,000	British dependency
L11	**Virgin Islands (U.S.)**	342	102,000	U.S. organized unincorporated territory
L11	**Virgin Islands, British**	153	13,000	British dependency; some self-government

Each country and dependency in North America has a separate article in *World Book.*

Populations are 1996 estimates for independent countries and 1995 and earlier estimates for dependencies based on the latest figures from official government and United Nations sources.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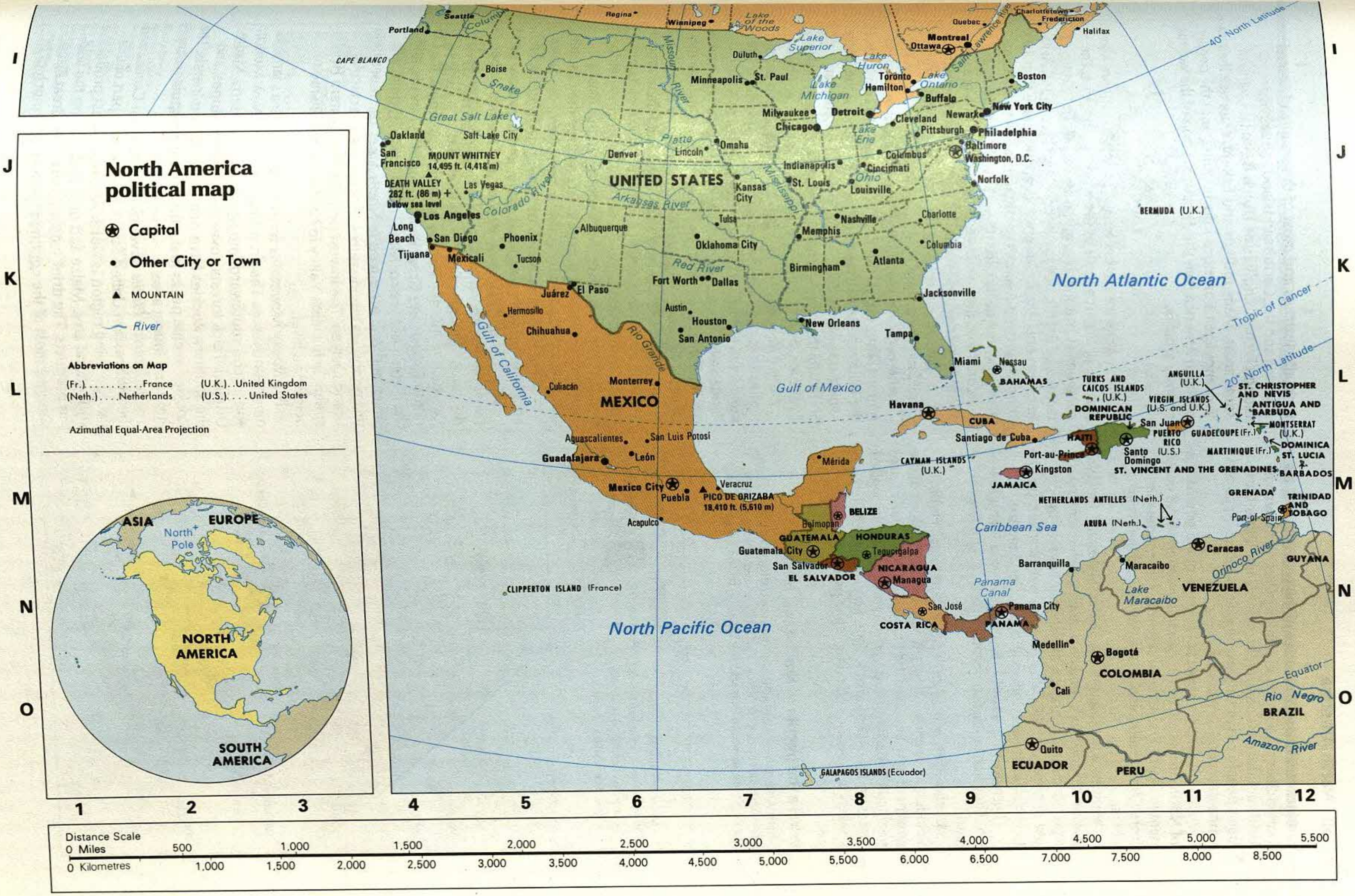
Yakutsk
Lena River
RUSSIA
Moscow
UKRAINE
BELARUS
St. Petersburg
LATVIA
ESTONIA
LITHUANIA
Arkhangelsk
Kara Sea
NOVAYA ZEMLYA
Barents Sea
Murmansk
FINLAND
Helsinki
Stockholm
Baltic Sea
SWEDEN
NORWAY
Oslo
Copenhagen
DENMARK
NORTH CAPE
SVALBARD (Norway)
Norwegian Sea
Sea of Okhotsk
Magadan
Laptev Sea
SEVERNAYA ZEMLYA
FRANZ JOSEF LAND
NEW SIBERIAN ISLANDS
Kolyma River
East Siberian Sea
Petropavlovsk-Kamchatskiy
North Pole
0°
20°
40°
60°
80°
100°
120°
140°
160°
180°
East Longitude
West Longitude
Greenland Sea
Arctic Ocean
CAPE MORRIS JESUP
International Date Line
Monday
Sunday
Chukchi Sea
FAEROE ISLANDS (Denmark)
UNITED KINGDOM
Denmark Strait
ICELAND
Reykjavik
80° North Latitude
GREENLAND (Denmark)
Arctic Circle
POINT BARROW
Bering Sea
ELLESMERE ISLAND
QUEEN ELIZABETH ISLANDS
Thule
DEVON ISLAND
Baffin Bay
Beaufort Sea
BANKS ISLAND
ALEUTIAN ISLANDS
UNITED STATES
Yukon
MOUNT MCKINLEY 20,320 ft. (6,194 m) (Highest point in North America)
Fairbanks
Anchorage
KODIAK ISLAND
VICTORIA ISLAND
BAFFIN ISLAND
Davis Strait
Godthåb
60° North Latitude
MOUNT LOGAN 19,524 ft. (5,951 m)
Gulf of Alaska
Whitehorse
Mackenzie River
Great Bear Lake
North Atlantic Ocean
Juneau
Yellowknife
SOUTHAMPTON ISLAND
North
Great Slave Lake
Labrador Sea
North
North Pacific Ocean
Peace River
Lake Athabasca
QUEEN CHARLOTTE ISLANDS
Hudson Bay
LABRADOR PENINSULA
CANADA
Athabasca
Nelson
Edmonton
St. John's
Saskatchewan
CAPE RACE
VANCOUVER ISLAND
Gulf of Saint Lawrence
ST.-PIERRE AND MIQUELON (France)
Vancouver
Victoria
Calgary
Saskatoon
Lake Winnipeg

North America political map



Blacks make up 12 per cent of the population of the United States. Most of the people of the Caribbean islands are descended from black Africans. Other Caribbean people are *mulattoes,* people of mixed black and white descent. See **Mulatto.**

Asians make up a small percentage of the population of North America. They began immigrating to the continent in the 1800's. Asian immigrants have come mainly from China, Indochina, Japan, Korea, and the Philippines.

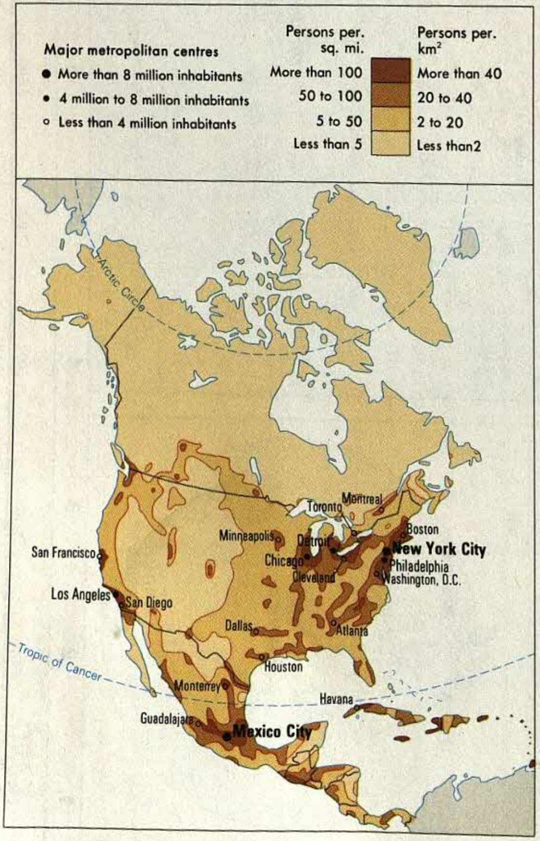
Many of the Indians in the United States and Canada live on reservations. Indians occupy much of central Mexico and parts of Central America. Most of the people of Mexico and Central America are *mestizos,* people of mixed white and Indian ancestry. See **Mestizo.**

There are only about 118,000 Eskimos in North America. They live in Alaska, northern Canada, and Greenland.

Languages. Most North Americans speak English, Spanish, or French. Generally, the various regions of the continent have retained the languages of the early European colonists. English is spoken throughout the United States and most of Canada. Both English and French are spoken in Quebec and some other parts of Canada. Almost all Mexicans and most of the people of Central America and the Caribbean islands speak Spanish, though French, English, or Dutch is the language of some areas. Many Indians and Eskimos still use their native languages. For more information about the people of North America, see the *People* section of the various country articles.

Where the people of North America live

North America ranks fourth among the continents in population, after Asia, Europe, and Africa. This map shows where the people of North America live and the location of the largest cities.



Land

North America covers about 24,249,000 square kilometres, or about a sixth of the world's land area. The continent is roughly triangular in shape. The Arctic, Atlantic, and Pacific oceans border the three sides. At its northern end, North America stretches more than 8,900 kilometres from Alaska's Aleutian Islands to the Canadian province of Newfoundland. At the southern end of the continent, the narrowest parts of Panama are only about 50 kilometres wide. The greatest north-south distance spans about 8,900 kilometres, from northern Greenland to Panama.

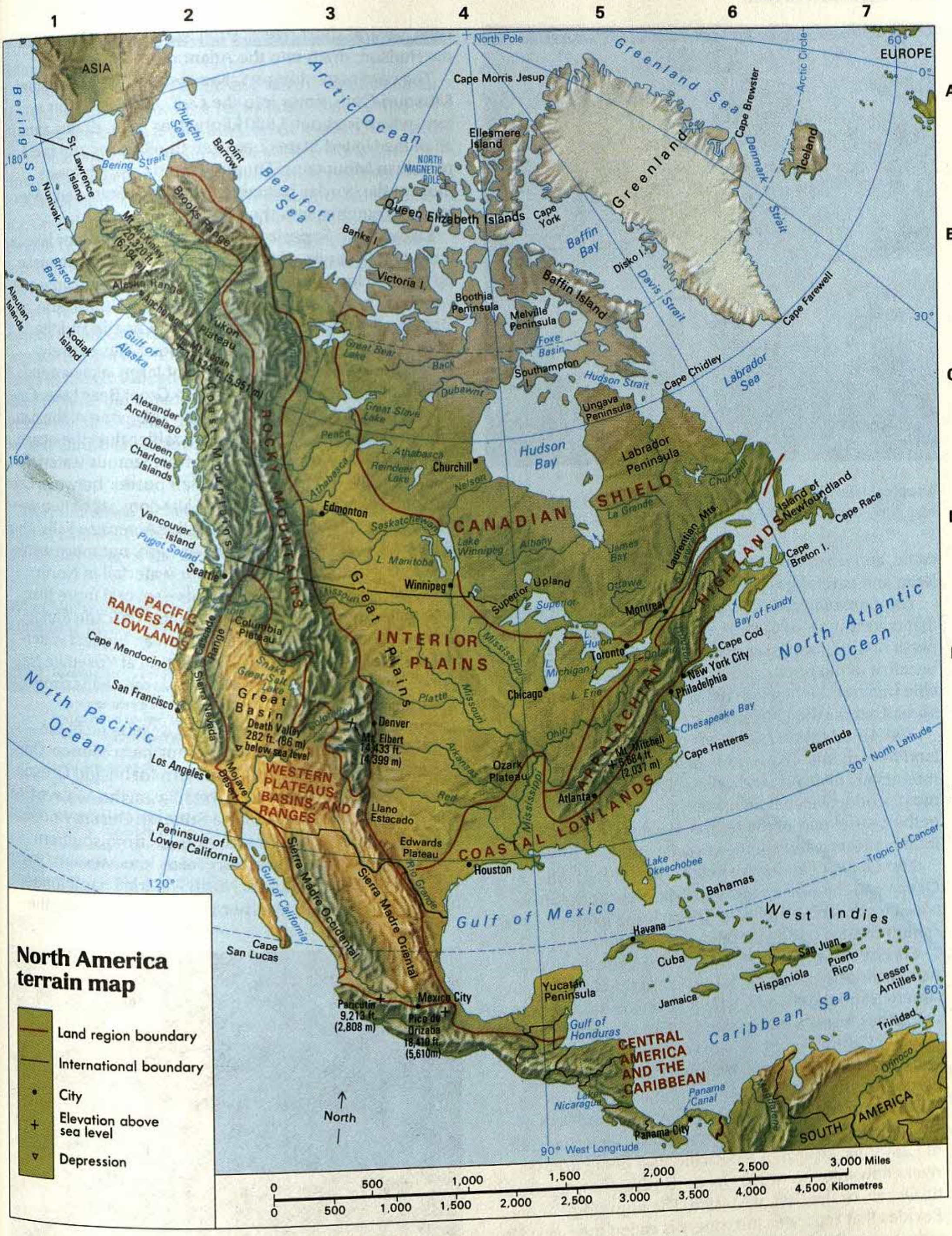
Land regions. North America has eight major land regions. They are (1) the Pacific Ranges and Lowlands, (2) the Western Plateaus, Basins, and Ranges, (3) the Rocky Mountains, (4) the Interior Plains, (5) the Canadian Shield, (6) the Appalachian Highlands, (7) the Coastal Lowlands, and (8) Central America and the Caribbean.

Pacific Ranges and Lowlands consist of two parallel mountain ranges separated by a series of valleys. The mountains extend all the way from Alaska to Mexico. Fertile valleys between the mountain ranges are productive agricultural centres. The outer ranges include the Olympic Mountains in Washington and the coastal mountains of Oregon and California. The inland ranges have the continent's tallest peaks and some of its most spectacular scenery. Mount McKinley, North America's highest mountain, rises 6,194 metres in the Alaska Range. The inland mountains also include the Cascade Range, which has many volcanic peaks, and the Sierra Nevada of California. Much of this ruggedly beautiful area is preserved as national, state, and provincial parks.

The Western Plateaus, Basins, and Ranges lie between the Pacific ranges and the Rocky Mountains. This dry region includes the Yukon River Basin in Alaska and Canada, the Interior Plateau of British Columbia, the Colorado Plateau, the Great Basin centred in Nevada, and the Plateau of Mexico. Much of the copper, gold, lead, silver, and zinc produced in North America comes from this region. Its land features include the spectacular Grand Canyon. The lowest point in the Western Hemisphere is in Death Valley in California. It is 86 metres below sea level.

The Rocky Mountains form North America's largest mountain system. They run from Alaska to New Mexico, and extend southward into Mexico as the Sierra Madre Oriental. Thick forests cover the northern slopes, and the southern Rockies have rich deposits of minerals. The Rockies' scenic peaks make the region a popular recreation and tourist area.

The Interior Plains cover much of central Canada and the Midwestern United States. The eastern part of this flat, low-lying region is North America's most productive agricultural area. Maize and pigs rank among the leading products. The drier western part—the Great Plains—supplies most of the continent's wheat and much of its



North America terrain map

Physical features

Alaska Range	B	2
Aleutian Islands	B	1
Arctic Ocean	A	3
Appalachian Highlands	E	5
Arkansas River	F	4
Baffin Bay	B	5
Bay of Fundy	E	6
Bering Sea	A	1
Bering Strait	A	2
Canadian Shield (region)	D	4
Cascade Range	E	2
Central America and the Caribbean	H	5
Chesapeake Bay	E	6
Coast Mountains	C	2
Coastal Lowlands	F	4
Colorado River	E	3
Columbia River	D	2
Death Valley	E	2
Fraser River	D	2
Great Bear Lake	C	3
Great Plains	E	3
Great Salt Lake	E	3
Great Slave Lake	C	3
Gulf of California	G	3
Hudson Bay	C	4
Hudson River	E	6
Interior Plains	E	4
James Bay	D	5
Lake Athabasca	C	3
Lake Erie	E	5
Lake Huron	E	5
Lake Michigan	E	5
Lake Nicaragua	H	5
Lake Ontario	E	5
Lake Superior	E	4
Lake Winnipeg	D	4
Mackenzie River	C	3
Mississippi River	E	4
Missouri River	E	4
Mojave Desert	F	2
Mount Logan	C	2
Mount McKinley	B	2
Nelson River	D	4
Ohio River	E	5
Pacific Ranges and Lowlands	E	2
Panama Canal	H	6
Paricutín (volcano)	G	3
Pico de Orizaba	G	4
Puget Sound	D	2
Rio Grande	G	4
Rocky Mountains	D	3
St. Lawrence River	E	5
Sierra Madre Oriental (mountains)	G	3
Sierra Nevada (mountains)	E	2
Vancouver Island	D	2
Western Plateaus, Basins, and Ranges	F	3
Yucatán Peninsula	G	5
Yukon River	B	2

Tropical islands, including Aruba, *above,* dot the Caribbean Sea. Their beaches attract large numbers of tourists.

cattle, and essential energy resources such as petroleum and natural gas.

The Canadian Shield is a huge area of ancient rock that covers most of Canada east of the Great Plains and north of the Great Lakes. Few people live in this region because of the poor soil and cold climate. Many valuable minerals lie beneath its surface. Evergreen forests spread across the southern part of the region.

The Appalachian Highlands extend from Newfoundland to Alabama. The region includes low, rounded mountains; plateaus; and valleys. One of the world's most productive coal fields lies in the Allegheny Plateau, in the central part of the region. Hardwood forests grow in the northern and southern sections.

The Coastal Lowlands stretch along the Atlantic Ocean and the Gulf of Mexico, from New York City to Mexico's Yucatán Peninsula. The rich soil in much of this region creates good farmland.

Central America and the Caribbean consist of the narrow bridge of land at the southern tip of North America and the islands in the Caribbean Sea. A chain of volcanoes forms a mountainous spine along the Pacific coast of Central America. Most of the Caribbean islands were created by volcanic eruptions. Others are coral and other limestone formations.

Rivers. West of the Rocky Mountains, the rivers of North America drain into the Pacific Ocean or the Gulf of California, an arm of the Pacific. East of the Rockies, rivers flow into the Arctic Ocean, Hudson Bay, the Atlantic Ocean, or the Gulf of Mexico. The high ridge of the Rockies that separates the waters is called the Great Divide, or the Continental Divide.

West of the Rockies, such rivers as the Yukon, Fraser, and Columbia rush to the Pacific through gaps in the coastal ranges. The Colorado River cuts through the Grand Canyon as it flows toward the Gulf of California.

The Mackenzie River, which forms part of Canada's longest river system, flows from Great Slave Lake into the Arctic Ocean. Many Canadian streams and rivers empty into Hudson Bay. East of the Appalachian Mountains, several short rivers, such as the Connecticut and the Hudson, drain into the Atlantic.

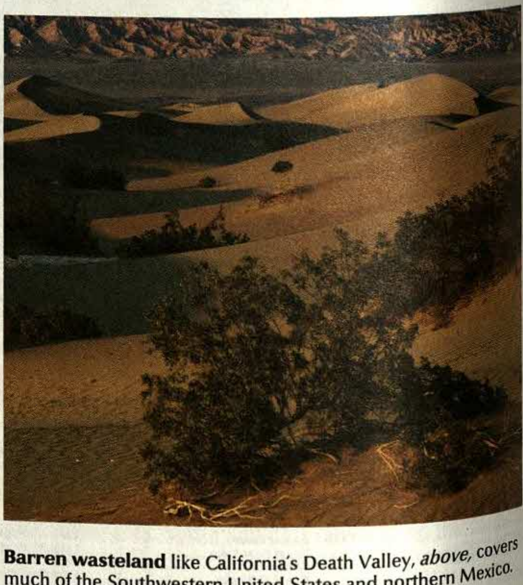
The continent's longest river system, the Mississippi-Missouri-Ohio, flows into the Gulf of Mexico. This system, which is about 7,600 kilometres long, drains almost all of the United States between the Rockies and the Appalachian Mountains. The Rio Grande, which forms most of the border between the United States and Mexico, also empties into the gulf.

Lakes. Lake Superior is the largest freshwater lake in the world. It is one of the five Great Lakes, which make up part of North America's most important inland waterway. Four of the Great Lakes—Superior, Huron, Erie, and Ontario—lie on the border between Canada and the United States. The fifth, Lake Michigan, lies entirely within the United States. A chain of large lakes extends northwest from the Great Lakes to Great Bear Lake, Canada's largest lake. Utah's Great Salt Lake, one of the natural wonders of North America, is saltier than the ocean.

Waterfalls. North America's most famous waterfall is Niagara Falls, on the U.S.-Canadian border between Lake Erie and Lake Ontario. Niagara Falls consists of two waterfalls, the Horseshoe Falls and the American Falls. The Horseshoe Falls is only 51 metres high, but more water passes over it than over any other waterfall in North America. A number of higher falls—several more than 300 metres high—plunge through the Cascade Range and the Sierra Nevada. North America's highest waterfall, Yosemite Falls, is a main attraction at Yosemite National Park in the Sierra Nevada. Yosemite Falls drops 739 metres.

Deserts. Most North American deserts lie in the Southwestern United States and northern Mexico. One vast dry area reaches from southern Idaho and Oregon into Mexico. It includes the Great Basin, the Mojave Desert and Death Valley, and the Sonoran Desert. Another area, the Chihuahuan Desert, extends from southern New Mexico through western Texas into Mexico.

Coastline and islands. North America has a longer total coastline than any other continent. Including the



Barren wasteland like California's Death Valley, *above,* covers much of the Southwestern United States and northern Mexico.

continent's many islands, the coastline is about 300,000 kilometres long.

Mountains line the Pacific and north Atlantic coasts, and many bays cut into the rocky land. Plains slope gently to the coasts along the Gulf of Mexico, the Caribbean Sea, and the Atlantic south of New York City. There, the coastline is relatively smooth and even.

A number of islands lie off the coasts of North America. Greenland is located in the North Atlantic Ocean. Although Greenland is part of North America, it is governed as a province of Denmark. Newfoundland and other islands lie off the Canadian coast in the Atlantic Ocean. In the Pacific Ocean, Vancouver and many other islands lie off Canada, and the Aleutian Islands extend westward from the tip of the Alaska Peninsula. The islands in the Caribbean Sea are called the West Indies. They include the Bahamas, the Greater Antilles, and the Lesser Antilles. Cuba, one of the Greater Antilles, is the largest Caribbean island.

Climate

North America is the only continent that has every kind of climate, from the dry, bitter cold of the Arctic to the steamy heat of the tropics. An icecap permanently covers the interior of Greenland, where the temperature almost never rises above freezing. In the North American *tundra,* the vast treeless plain of the far north, the temperature rises above freezing for only a short period each summer. In the low-lying areas of the far south, it is hot and rainy all the time.

Most of the rest of North America is cold in the winter and warm in the summer, with moderate precipitation. Some areas have mild winters and long, hot summers. Other areas have harsh winters and short summers. The highest temperature ever recorded in North America was 57° C at Death Valley in 1913. The lowest temperature was −66° C at Northice in Greenland in 1954.

Animal life

North America has abundant animal life, which varies with the climate and plant life of each region. Caribou, musk oxen, polar bears, seals, snowy owls, whales, and wolverines live in the cold north. Jaguars, monkeys, and colourful birds are found in tropical Central America. Rocky Mountain sheep and goats graze on the slopes of the Rockies. The southwestern deserts have a wide variety of lizards and rattlesnakes. Coyotes and prong-

What North America's climate is like

▨ **Icecap:** Always cold. Average monthly temperature never above freezing. Precipitation always snow.

▨ **Polar:** Always cold with brief chilly summers. Little precipitation in all seasons.

▨ **Subarctic:** Short cool summers and long cold winters. Light to moderate precipitation mostly in summer.

▨ **Oceanic moist:** Moderately warm summers and generally cool winters. Moderate precipitation in all seasons.

▨ **Continental moist:** Warm to cool summers and cold winters. Moderate precipitation in all seasons.

▨ **Subtropical moist:** Warm to hot summers and cool winters. Moderate precipitation in all seasons.

▨ **Subtropical dry summer:** Hot, dry summers and mild winters. Moderate precipitation in winter.

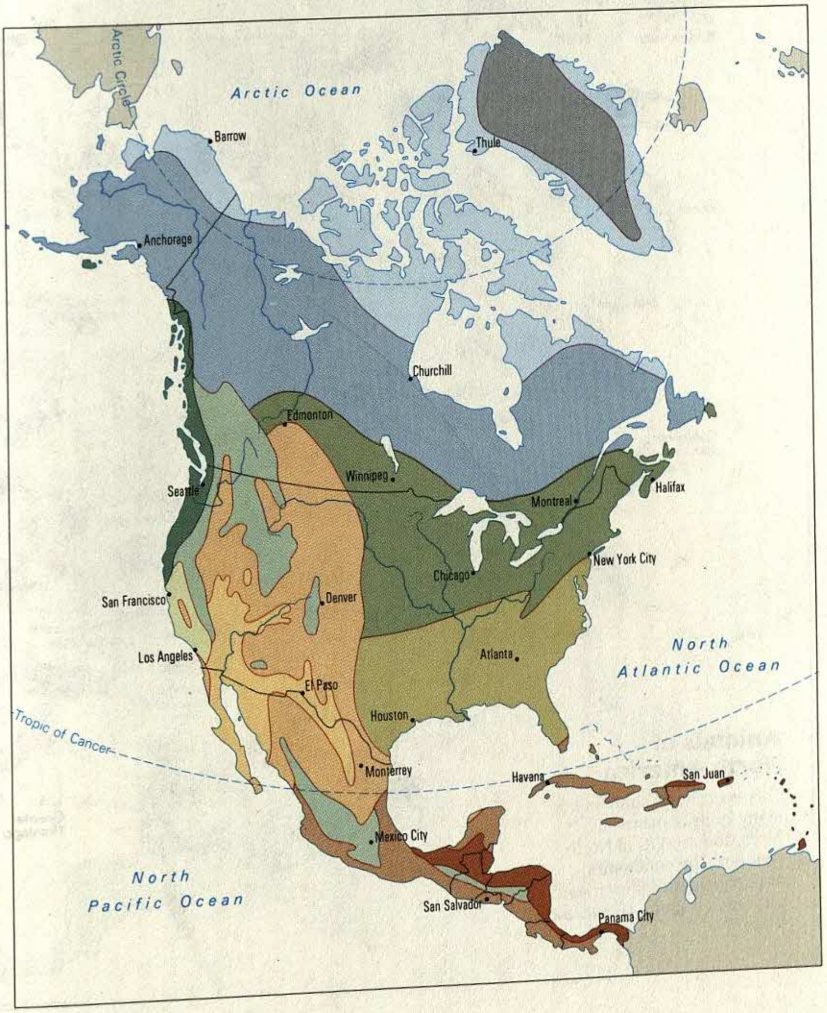
▨ **Semiarid:** Hot to cold. Great changes in daily temperature except near coast. Light precipitation.

▨ **Desert:** Hot to cool. Great changes in daily temperature except near coast. Very little precipitation.

▨ **Tropical wet and dry:** Always hot. Both wet and dry seasons. Heavy precipitation in wet season.

▨ **Tropical wet:** Always hot and always wet. Heavy precipitation well distributed throughout the year.

▨ **Highland:** Because of altitude, highlands are generally cooler and wetter than adjacent areas.



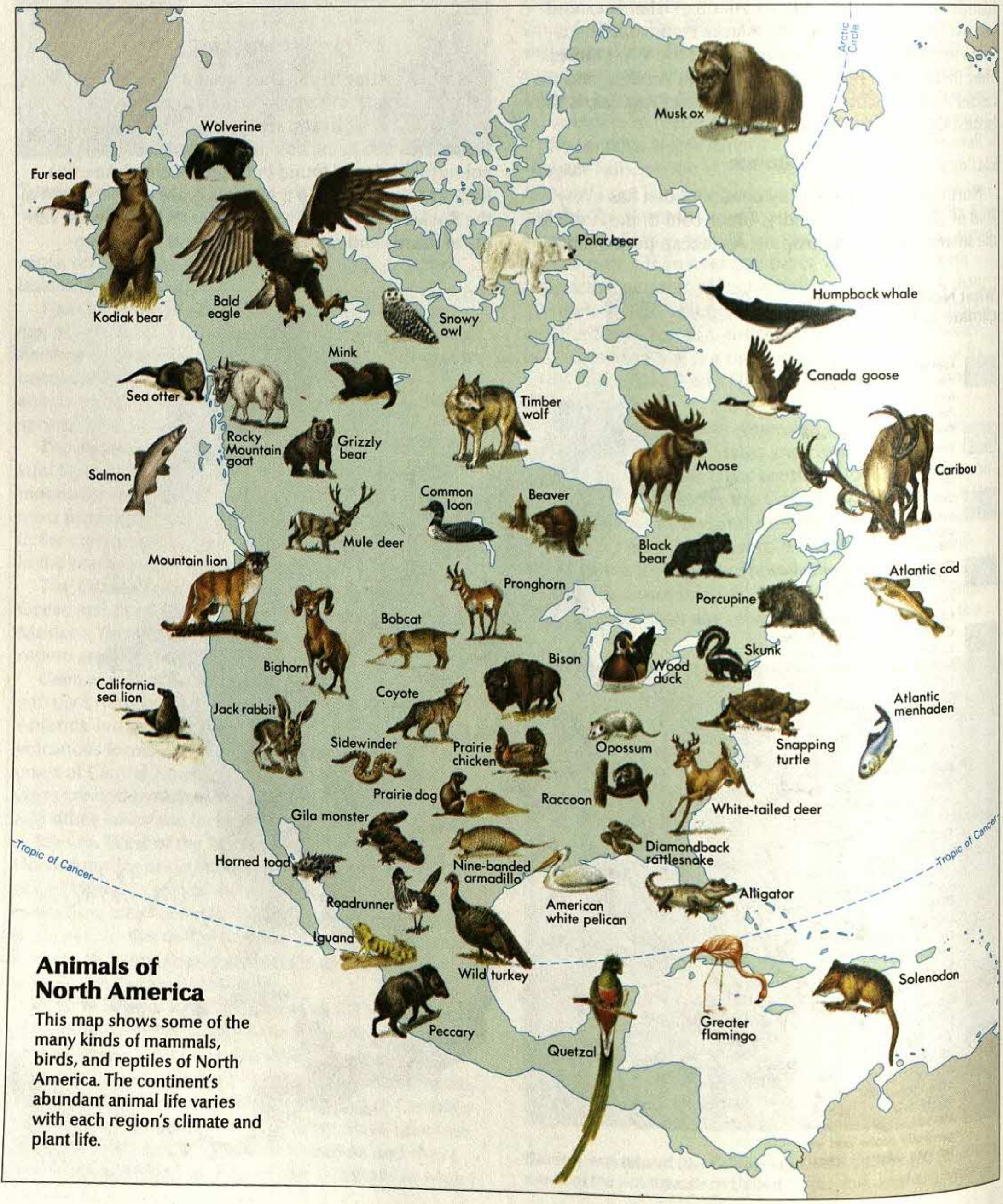
horns—animals that are found only in North America—roam the Great Plains. The forests of Canada and the Eastern United States have beavers, black bears, deer, ermines, minks, moose, muskrats, and porcupines. Canadian geese, ducks, egrets, pelicans, and spoonbills are among the birds that winter in the marshes of the Coastal Lowlands, and alligators live in the coastal waters of the far south. Raccoons, skunks, and squirrels are common throughout the continent.

The oceans supply commercial fishing crews with valuable catches of cod, flounder, and many other kinds of fish and shellfish. Crabs are plentiful in the northern Pacific, cod and lobsters in the northern Atlantic, and menhaden all along the Atlantic coast. Shrimp and oysters are abundant in the Gulf of Mexico.

Certain kinds of wildlife have decreased sharply in number over the years. These include the bison (buffalo), the whooping crane, and the bald eagle. Game laws and the establishment of protected areas help such animals survive today.

Plant life

The plant life of North America is related to the continent's various climates. Nothing grows on Greenland's



Animals of North America

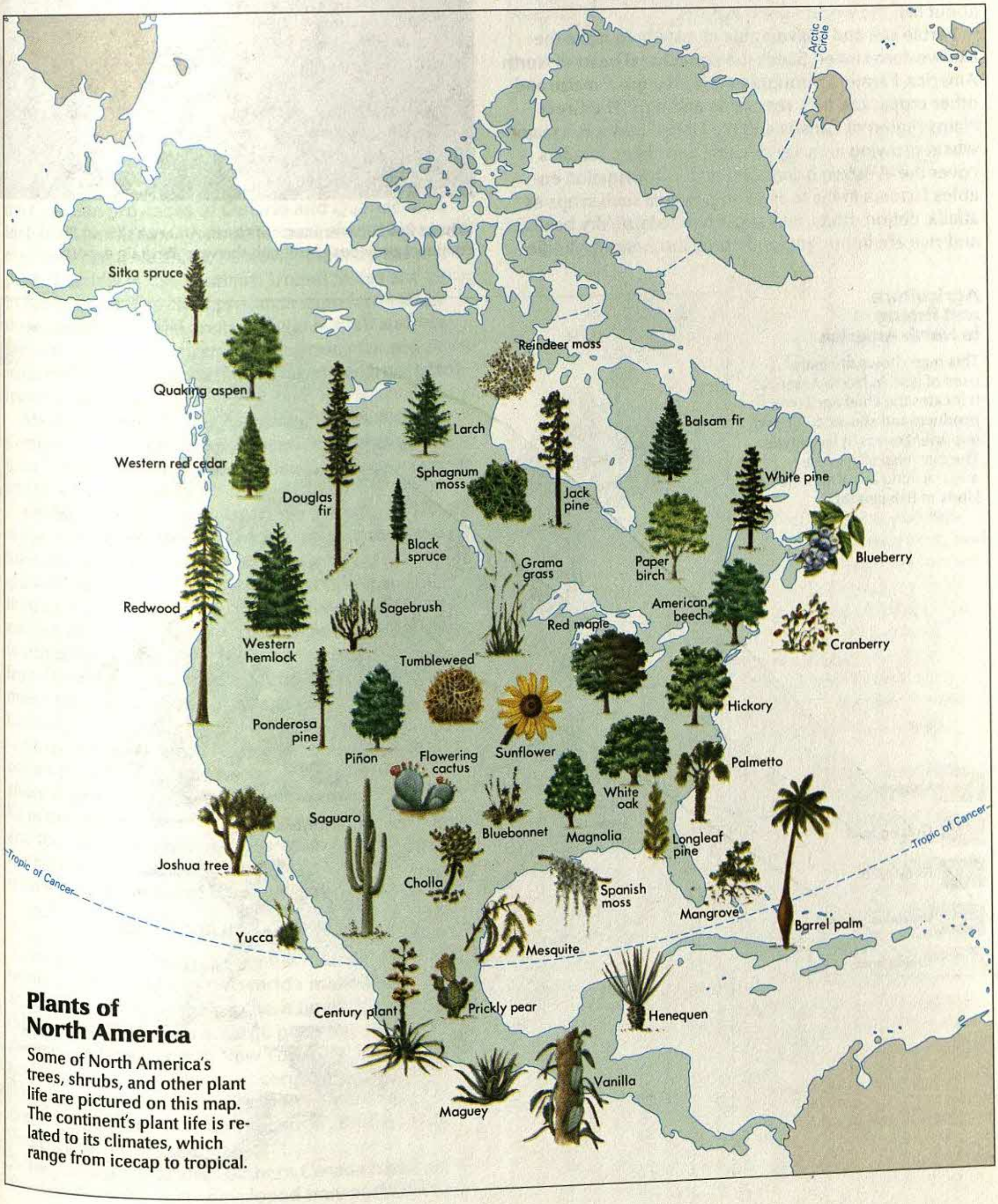
This map shows some of the many kinds of mammals, birds, and reptiles of North America. The continent's abundant animal life varies with each region's climate and plant life.

icecap. Only grasses, mosses, and lichens survive in the vast cold plains that border the Arctic Ocean. A kind of moss called *sphagnum* or *peat* fills the marshes of the Canadian Shield and is an important export from this region. Huge saguaro cactuses and other cactus plants grow in the southwestern deserts. Short grasses and small bushlike plants such as tumbleweed cover the dry Great Plains.

Most of the rest of the continent has forests and level or rolling grasslands called *prairies.* The prairies stretch across the centre of the continent. The forests cover the continent's western mountain regions, most of Canada, and the eastern half of the United States. A tropical rain forest grows along the Caribbean coast.

The finest North American forests are those along the Pacific coast. The towering redwoods stand there, as well as forests of cedar, fir, hemlock, and spruce.

The Canadian forests include fir, larch, pine, and spruce trees. Hardwood trees such as maple and beech grow in the Northeastern United States. Many of the trees that grow in Canada and the Northeastern United States are processed into wood pulp for newsprint. Hickory, oak, and pine trees fill the forests of the Southern United States. Central America's tropical forests in-



Plants of North America

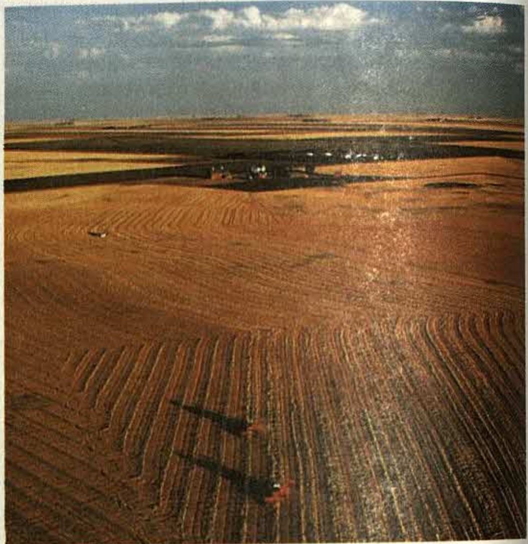
Some of North America's trees, shrubs, and other plant life are pictured on this map. The continent's plant life is related to its climates, which range from icecap to tropical.

clude mahogany and rosewood trees, which are used in making furniture.

Agriculture

North America ranks third among the continents after Asia and Europe in agricultural production. Its farms grow about three-fifths of the world's soybeans and about half the world's maize, flaxseed, and sorghum grain. North American farms produce about a fourth of the world's citrus fruits and oats, and a fifth of its cotton and wheat. Farmers in the United States and Canada grow so much food that large quantities may be sent to other countries. For example, North America provides about half the world's grain exports.

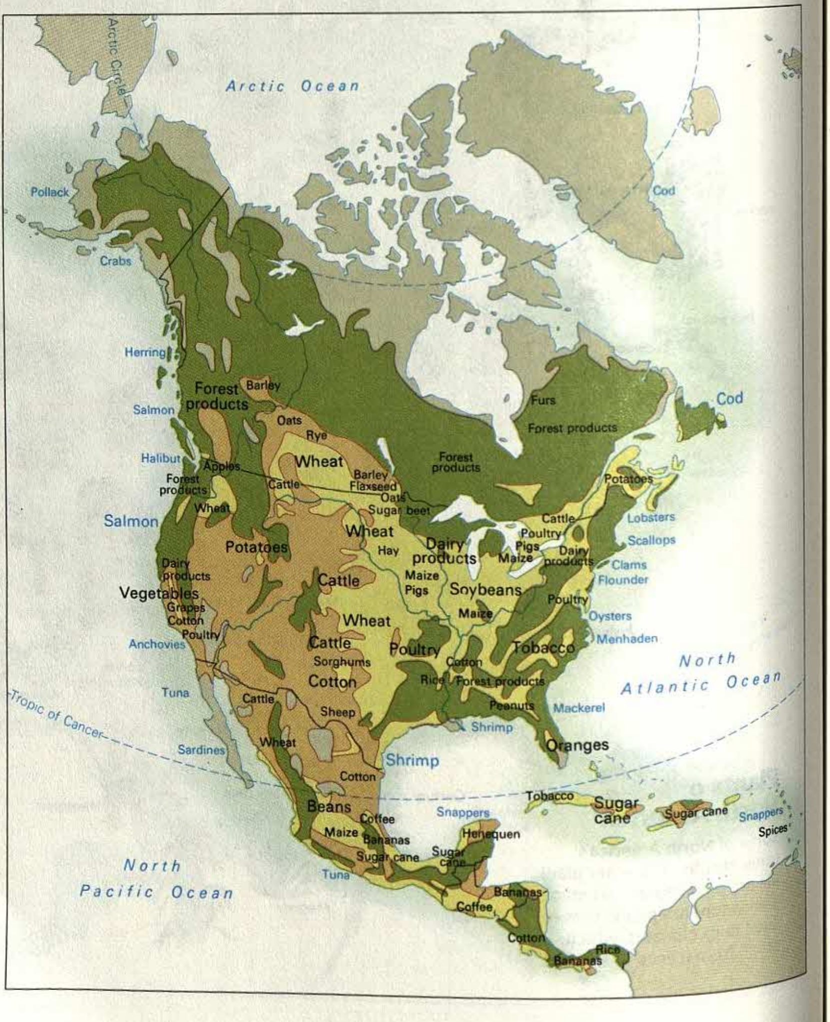
Fertile soil and a favourable climate help make the Midwestern United States the agricultural heart of North America. Farmers throughout this area grow maize and other crops, and they rear cattle and pigs. The Great Plains region of Canada and the United States is a major wheat-growing area. Large cattle and sheep ranches cover the Western basins and plateaus. Irrigation enables farmers in these areas to produce such crops as alfalfa, cotton, fruits, and sugar beet. Maize, dry beans, and rice are important food crops throughout Middle



Wheat fields cover much of North America's Great Plains. The continent provides about half the world's grain exports.

Agriculture and fishing in North America

This map shows the major uses of land in North America. It locates the chief agricultural products and shows the most important crops in large type. The map also shows the major fishing areas and the kinds of fish caught.



- 🟨 Cropland
- 🟫 Grazing land
- 🟩 Forest land
- ▨ Unproductive land
- ☐ Fishing areas

America. Large plantations located in the region produce such crops as bananas, coffee, cotton, and sugar cane.

Only about 4 per cent of United States and Canadian workers farm. Most of the farmers own all or at least part of their land. In Middle America, about half the people farm, and few of them own their own land. Many work as labourers on large plantations. Some own or rent small plots of land on which they struggle to grow enough food to feed their families.

Industry

Manufacturing. North America ranks second to Europe among the continents in manufacturing. Together, the United States and Canada produce about a third of the world's manufactured goods. The continent's chief manufactured goods include motorcars and motorcar parts, chemical products, and food products. Manufacturing employs about a fifth of all North American workers.

The Midwestern and Northeastern United States and the Canadian provinces of Ontario and Quebec have long been North America's major manufacturing centres. Since the mid-1900's, however, industry has expanded rapidly in the Southern United States and along its Pacific coast. The chief products from factories in these newer industrial areas include aircraft and missiles, computers and electronic components, and petroleum and *petrochemicals* (chemicals made from petroleum or natural gas).

Manufacturing also has grown in Middle America. Cement and fertilizer are produced throughout the region. The Bahamas and Puerto Rico produce medicines and other goods.

Mining. North America has large supplies of a broad range of minerals. The continent produces about two-fifths of the world's silver and about a third of its natural gas and nickel. North America also provides about a third of the world's supply of phosphate rock and potash, which are chiefly used to make fertilizer. About a fourth of the world's copper, crude oil, and lead comes from North America, as does a fifth of its coal. Fewer than 1 per cent of all North American workers have jobs in mining.

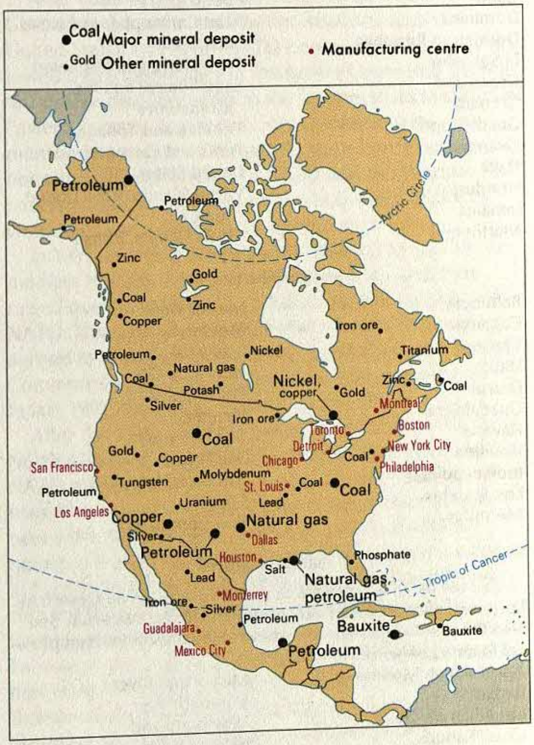
Most of North America's petroleum and natural gas comes from the Great Plains region, Alaska, and offshore deposits in the Gulf of Mexico. Major coal fields lie in the Appalachian Plateau, the central United States, and the Rocky Mountain region. Metallic minerals come mainly from the Canadian Shield, the Rockies and other western mountains, and the Appalachian Highlands.

Transportation and communication

North America lies between the Atlantic and Pacific oceans in the middle of the world's major trade routes. The Panama Canal at the southern tip of the continent connects the two oceans. Large ports line North America's east and west coasts. New York City, New Orleans, and Houston handle the most cargo of ports that serve the Atlantic coast. The leading ports on the Pacific Coast are Valdez Harbor, Alaska; Vancouver, British Columbia; and Long Beach, California.

Mining and manufacturing in North America

This map shows the location of North America's chief mineral resources and manufacturing centres Major mineral-producing areas are shown in large type, and lesser ones in small type.



The United States and southern Canada have one of the world's most highly developed transportation systems, including inland waterways, highways, and railways. The Mississippi River system, the Great Lakes, and the St. Lawrence Seaway form North America's most important inland waterways. Highways and railway lines crisscross the United States and southern Canada. Few roads lead into northern Canada. In Mexico, paved roads and railway lines link major cities. In Central America and the Caribbean, most local roads are unpaved, and most railway companies are small, private lines that connect sugar or banana plantations with processing plants and ports.

North America has the world's best regional airline network. Most flights serve the large cities of the United States and southern Canada. The world's busiest airports are located in the United States.

North America also has the best communications system of any continent. Radios and televisions are common in U.S. and Canadian households. Many people in Middle American countries own radios, but televisions are less widespread. About 2,000 daily newspapers are published in North America. Most North American newspapers and radio and television broadcasting stations are privately owned, except in Cuba and Nicaragua, where the government controls most communications.

Related articles in ***World Book*** include:

Countries, colonies, and territories

Anguilla
Antigua and Barbuda
Bahamas
Barbados

Belize
Bermuda
Canada
Cayman Islands
Costa Rica
Cuba
Dominica
Dominican Republic
El Salvador
Greenland
Grenada
Guadeloupe
Guatemala
Haiti
Honduras
Jamaica
Martinique
Mexico
Montserrat
Netherlands Antilles
Nicaragua
Panama
Puerto Rico
Saint Christopher and Nevis
Saint Lucia
Saint-Pierre and Miquelon
Saint Vincent and the Grenadines
Trinidad and Tobago
Turks and Caicos Islands
United States
Virgin Islands of the United States
Virgin Islands, British

Large cities

Baltimore
Calgary
Chicago
Dallas
Detroit
Guadalajara
Havana
Houston
Indianapolis
Los Angeles
Memphis
Mexico City
Monterrey
Montreal
New York City
Philadelphia
Phoenix
San Antonio
San Diego
San Francisco
Toronto
Washington, D.C.

Natural features

See the list of *Related articles* with the articles on **Desert; Inland waterway; Island; Lake; Mountain; River; Waterfall.** See also the following articles on some of the most important physical features of North America:

Appalachian Mountains
Badlands
Canadian Shield
Coast Ranges
Death Valley
Everglades
Grand Canyon National Park
Great Basin
Great Bear Lake
Great Divide
Great Lakes
Great Salt Lake
Great Slave Lake
Greenland
Klondike
Lake Nicaragua
Mackenzie River
Mississippi River
Missouri River
Newfoundland
Niagara Falls
Niagara River
Orizaba, Pico de
Painted Desert
Paricutín
Popocatépetl
Rio Grande
Rocky Mountains
Saint Lawrence River
Sierra Madre
West Indies
Yellowstone National Park
Yosemite National Park
Yukon River

Coastal waters

Arctic Ocean
Atlantic Ocean
Bay of Fundy
Bering Sea
Caribbean Sea
Chesapeake Bay
Gulf of California
Gulf of Mexico
Gulf of Saint Lawrence
Hudson Bay
Pacific Ocean
Puget Sound

People

City
Food
Indian, American
Inuit
Population
World

History

See the *History* section of the articles on the countries of North America. See also the following articles:

Canada, History of
Central America
Exploration
Latin America (History)
United States, History of the

Outline

I. People
  A. Population
  B. Ancestry
  C. Languages
II. Land
  A. Land regions
  B. Rivers
  C. Lakes
  D. Waterfalls
  E. Deserts
  F. Coastline and islands
III. Climate
IV. Animal life
V. Plant life
VI. Agriculture
VII. Industry
  A. Manufacturing
  B. Mining
VIII. Transportation and communication

Questions

Which animals are found only in North America?
Which bodies of water make up North America's most important waterways?
What is North America's highest mountain?
Which countries form Anglo-America?
Where has industry expanded rapidly in North America since the mid-1900's?
Which island is the largest of the Caribbean islands?
What is the Great Divide?
Which plant is an important export from the Canadian Shield?
Who were the first settlers to arrive in North America?
Which land region includes North America's most productive agricultural area?

North Atlantic Treaty Organization (NATO) provides unified military leadership for the common defence of 16 Western nations. NATO was established in 1949 by the nations allied by the North Atlantic Treaty, which provided for their collective defence against a possible attack by the Soviet Union or any other aggressor. The treaty provides that an armed attack against one or more member nations in Europe or North America shall be considered an attack against all members of the alliance.

Twelve nations signed the North Atlantic Treaty on April 4, 1949, in Washington, D.C. They were Belgium, Canada, Denmark, France, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, the United Kingdom and the United States. Greece and Turkey signed the treaty in 1951, West Germany in 1954, and Spain in 1982. West Germany had been created in 1949, when the nation of Germany was divided into West Germany and East Germany. In 1990, Germany was reunited and replaced West Germany as a NATO member.

Organization. NATO's military forces are organized into three main commands: the Atlantic Command, Channel Command, and Allied Command Europe. Most of NATO's forces are in Allied Command Europe, which is directed by the Supreme Allied Commander in Europe (SACEUR). The Military Committee of NATO, consisting of the chiefs of staff of the member nations, establishes military policy to be carried out by SACEUR. The committee is responsible to the North Atlantic Council, which consists of the heads of the member nations or their representatives. All decisions of the council must be unanimous. The headquarters of the North Atlantic Council are in Brussels, Belgium.

To deter an attack by an aggressor, NATO relies partly on nuclear weapons. The United States provides most of these weapons. This dependence on U.S. nu-

The North Atlantic Council, *above,* is the highest authority in NATO. It plans for the collective defence of North America and Western Europe. It consists of the representatives of the member countries. The NATO secretary general serves as council chairman. The presidency of the council rotates annually.

clear arms has made the United States NATO's dominant member. The SACEUR is always a U.S. general.

History. In 1949, the nations of Western Europe were weak and could not easily defend themselves against attack. In addition, all the nations of Eastern Europe had come under Communist rule. The Communist seizure of power in Czechoslovakia in February 1948 and the Soviet blockade of Berlin in June 1948 raised fears that the Soviet Union might use armed force to gain control of Western Europe.

By signing the North Atlantic Treaty, the United States for the first time in its history joined a peacetime alliance that committed it to fight in Europe. U.S. leaders felt that the United States would have to fight against Soviet seizure of Western Europe because such a seizure would add greatly to the power of the Soviet Union to attack the United States. U.S. leaders hoped that the Soviet Union would not attack Western Europe if it knew it would have to fight the United States, too. In 1955, the Soviet Union and its Communist allies in Eastern Europe formed their own military alliance by signing the Warsaw Pact.

NATO has survived a number of differences among its members. For example, in the 1960's, the European members began to wonder if the United States would really use nuclear weapons in defence of Western Europe, in view of the Soviet Union's growing nuclear power. European members of NATO resented the fact that NATO had no control over U.S. national nuclear commands. They also disliked the fact that NATO could not influence U.S. foreign policy in other parts of the world, even though these policies might lead to a war in Europe. For their part, Americans resented the fact that Europeans did not furnish more nonnuclear forces, and the United Kingdom and France instead spent their money developing nuclear weapons. These differences contributed to France's decision in 1966 to expel NATO forces and to withdraw French forces from NATO command. France keeps its forces out of NATO but remains a member of the alliance.

In 1974, Greece withdrew its forces from NATO command because the United Kingdom and the United States did not prevent Turkey's invasion of Cyprus. Greece rejoined the military wing of NATO in 1980.

After coming to power in 1985, Soviet leader Mikhail Gorbachev began to seek better relations with the United States and other NATO countries. Gorbachev allowed more democracy in the Soviet Union and permitted similar developments in the Communist countries of Eastern Europe. As a result, non-Communist governments came to power in many Eastern European nations. In 1990, the leaders of NATO and the Warsaw Pact countries signed an agreement that the two alliances would not use military force against each other.

In 1991, further developments seemed to end any immediate military threat to NATO countries, and thus raised questions about the future role and purpose of NATO. That year, for example, the Warsaw Pact nations agreed to dissolve their alliance. In addition, the Soviet Communist Party lost control of the Soviet government. In late 1991, the Soviet Union was dissolved.

After the Warsaw Pact's collapse, NATO formed the North Atlantic Cooperation Council, which included NATO members as well as former Warsaw Pact countries. The council was designed to strengthen ties between the two groups of nations. In 1991, NATO announced that it would cut its supply of nuclear weapons in Europe by 80 per cent. NATO expanded its military role in 1992 by making its forces available for peacekeeping assistance to non-NATO European countries. In February 1994, NATO undertook its first ever combat action when aircraft from the organization shot down four Bosnian Serb jets that had violated the United Nations-imposed no-fly zone over Bosnia-Herzegovina.

Also in 1994, 20 countries, many of them former Communist states, enrolled in an association with NATO called "partnership for peace". The association provided for military participation by these countries, and may be a first step towards full membership of NATO.

See also **Flag** (picture: Flags of world organizations); **Warsaw Pact.**

North Bedfordshire. See **Bedford Borough.**

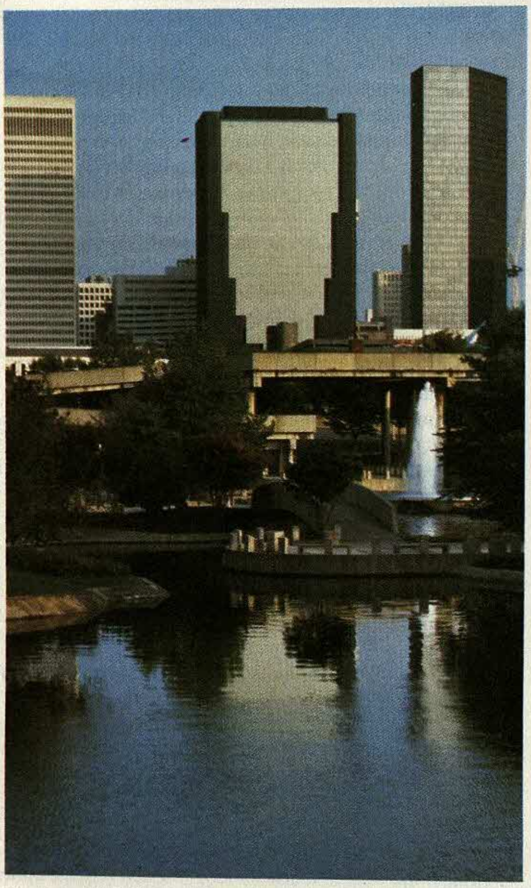
North Carolina (pop. 6,657,630) is a state in the southern United States. It is a leading area in tobacco farming and in the manufacture of tobacco products. North Carolina is also important in the production of textiles and wooden furniture. Raleigh is the state capital.

North Carolina has a long, treacherous coastline on the Atlantic Ocean. Rough seas have wrecked many ships at Cape Hatteras, which is sometimes called the *Graveyard of the Atlantic.*

The Atlantic Coastal Plain of eastern North Carolina extends inland through low, level marshland covered by trees and water. *Savannas* (treeless prairies) are found in the eastern part of the region. The western part has rich farmland. Sand hills rise in the south.

The Piedmont is a hilly region in the central portion of North Carolina. Rivers plunge from the Piedmont to the flat coastal plain along the boundary between the two regions, called the Fall Line.

The Mountain Region rises in the western part of the state. The Blue Ridge Mountains are North Carolina's chief range. All of the ranges form part of the Appalachian Mountains. Forests cover much of the mountains.



Charlotte is the largest city in North Carolina. It serves as a major centre for finance, transport, and the wholesale trade.

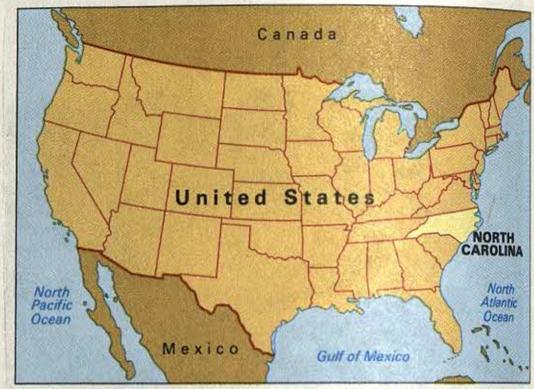
Service industries, taken together, account for much of North Carolina's income. Wholesale and retail trade ranks as the most valuable service industry. Research Triangle Park, a large industrial complex in the Raleigh-Durham area, is a leading national research centre for the electronics, medical, and other industries.

Charlotte is an important U.S. financial centre. Education and health care employ many people. The state's largest universities are in Chapel Hill and Raleigh.

Manufacturing is the single most valuable industry in the state. Tobacco is North Carolina's main farm product, and tobacco products are among its leading manufactured goods. The state also is an important producer of chemicals, furniture, and textiles.

History. About 35,000 Indians, belonging to about 30 tribes, lived in the North Carolina region when Europeans first arrived in the 1500's. In 1585 and 1587, the English established on Roanoke Island their first American colonies. The first settlement was abandoned after a year. The second settlement mysteriously vanished, and it came to be called the *Lost Colony.*

During the late 1600's and early 1700's, many settlers were attracted to the region. The settlers battled with the Indians, and pirates terrorized North Carolina's coastline.



North Carolina has a long coastline on the Atlantic Ocean. Islands, reefs, and sand bars make its shores treacherous.

Many North Carolinians sympathized with the Union during the American Civil War (1861-1865), even though the state *seceded* (withdrew) on May 20, 1861. North Carolina rejoined the Union on June 25, 1868.

The state's industries developed at a tremendous rate during the early 1900's. In 1956, three universities combined their resources to form the North Carolina Research Triangle Park, a research centre that serves industry.

In 1960, four black students remained seated at a restaurant in Greensboro after they were refused service. Their action sparked a wave of demonstrations in the South.

North Carolina's traditional industries faced an uncertain future in the early 1990s. Health concerns about smoking threatened the tobacco industry. Many textile mills found it difficult to compete with foreign competitors who offered low prices.

See also **Lost Colony; Blackbeard.**

North Cornwall (pop. 73,700) is a local government district in Cornwall, England, administered from Bodmin. The district includes Bodmin Moor. Bodmin is a centre of light industry. Launceston and Tintagel have famous castles. Padstow, with its busy harbour, is noted for fishing and boat building. Bude is a resort with a fine beach.

North Dakota (pop. 641,364) is a state in the Midwestern region the United States. It lies in the centre of the North American continent. North Dakota is mainly a farm state. It is often called the *Flickertail State,* because of the many flickertail ground squirrels that live there.

North Dakota is one of the smallest U.S. states in population, and half of its people live in rural areas. Fargo is the largest city, and Bismarck, the state capital, is second largest.

Land. North Dakota covers 183,119 square kilometres. Along its eastern border lies the Red River Valley, a flat farming area. North Dakota's lowest elevation, 229 metres, is found in the northeastern corner. A prairie rises on the western border of the valley. It has rolling hills and many small lakes. The Great Plains cover the southwestern half of North Dakota. The Badlands of the Little Missouri River lie in the southwest. Wind and water have carved unusual formations out of sandstone, shale, and clay in this area. The highest point in the

North Dakota lies at the centre of the North American continent. Farming is the state's main economic activity.

state, White Butte, rises 1,069 metres in the Badlands. Temperatures in North Dakota average −14° C in January, and 21° C in July.

Cropland and pastures cover about 90 per cent of North Dakota. Wheat ranks as the leading crop. Other farm products, in order of importance, include beef cattle, barley, hay, sunflower seeds, and milk.

Service industries employ about three-fourths of the state's workers. They include education, health care, housing, and retail trade and are especially important in urban areas.

Petroleum is the state's leading mineral product. Coal is also important. Food processing is the chief manufacturing activity in North Dakota.

Several Indian tribes lived in the North Dakota region before white people first arrived. The state was named after the Sioux Indians, who called themselves *Dakota* or *Lakota,* meaning *allies* or *friends.*

During the 1600's and 1700's, parts of the region were ruled by France, Spain, and Great Britain. All of present-day North Dakota had become U.S. territory by 1818. Large-scale farming began in the area during the 1870's. On Nov. 2, 1889, North Dakota became a U.S. state.

Construction of the great Garrison Dam, near Riverdale, began in 1946 and was completed in 1960. In 1968, construction began on the Garrison Diversion Project to increase the state's water supply. In 1986, the U.S. Congress modified the project for environmental reasons.

North Devon (pop. 85,100) is a rural local government district in Devon, England, extending from the Taw and Torridge estuary to Lynmouth. Its chief towns are Barnstaple, Ilfracombe, and South Molton. Agriculture and tourism are the principal industries. Barnstaple also has industries involved in light engineering and in the manufacture of doors and pharmaceuticals.

North Dorset (pop. 52,200) is a local government district in Dorset, England, containing the towns of Blandford Forum, Gillingham, Shaftesbury, and Sturminster Newton, and many attractive villages. The district is chiefly rural, with large tracts of woodland. Blandford is an industrial centre.

North Down (pop. 70,065) is a residential local government district in Northern Ireland, administered from the resort of Bangor. The district lies on the southern shores of Belfast Lough, and yachting is popular. Just outside Hollywood is the Ulster Folk Museum. Local industries include light engineering, making packaging materials, and shipbuilding.

North East Derbyshire (pop. 95,600) is a local government district in Derbyshire, England, administered from the neighbouring borough of Chesterfield. It contains the towns of Clay Cross, Dronfield, Eckington, and Killamarsh, which all grew because of coal mining, iron, and engineering industries. Some of these traditional industries are being replaced by high technology and service industries. The south and west of the district are rural, and include part of the Peak National Park.

North East Fife (pop. 69,181) is a local government district in Fife Region, Scotland, administered from Cupar. Tourism and agriculture are the main occupations. The district supports some fishing, notably at Pittenweem and Anstruther, and other industries. North-East Fife includes Falkland Palace and St. Andrew's Golf Course.

North Equatorial Current. See Gulf Stream (map).

North German Confederation. See Germany (History: The unification of Germany; map).

North Hertfordshire (pop. 108,600) is a local government district in Hertfordshire, England. It includes the market towns of Baldock, Hitchin, Royston, and Letchworth, Britain's first garden city. Hitchin is the main industrial centre, producing a variety of goods. Hitchin Priory, now an education centre, dates from 1771. Knebworth has a famous historic house.

North Kesteven (pop. 78,400) is a local government district in Lincolnshire, England, administered from the market town of Sleaford. The district is almost exclusively agricultural, producing root crops, vegetables, cereals, and flowers. Cranwell RAF college is in the district.

North Korea. See Korea.

North magnetic pole. See North Pole.

North Norfolk (pop. 90,400), a local government district in Norfolk, England, includes the coastal resorts of Cromer, Sheringham, and Wells-next-the-Sea, and the market towns of North Walsham and Fakenham. A North Sea gas pipeline terminal is at Bacton. Holkham Hall is a historic house of the 1700's. Walsingham is a place of religious pilgrimage.

North Pole is a term used for several invisible surface points located in the Arctic region. The best known is the north geographic pole. But other important north poles include the instantaneous north pole, the north pole of balance, the north magnetic pole, and the geomagnetic north pole.

The north geographic pole lies near the centre of the Arctic Ocean at the point where all the earth's lines of longitude meet. American explorer Robert E. Peary led the first expedition to reach the north geographic pole. The expedition included Matthew Henson, who was Peary's assistant, and four Eskimos. They made the trip by dog team in 1909. In 1926, Admiral Richard E. Byrd and Floyd Bennett of the United States reached the pole by aeroplane. In 1958, the U.S.S. *Nautilus* became the first submarine to pass under the Arctic ice to the pole. In 1978, Naomi Uemura of Japan became the first person to reach the pole alone. He travelled by dog sledge.

The instantaneous north pole lies at the point where the earth's *axis* (an imaginary line through the earth) meets the surface. The earth wobbles slowly as it turns around its axis, causing the instantaneous north pole to move. This pole takes about 14 months to move clockwise around an irregular path called the *Chandler Circle.* The diameter of this circle varies from less than 30 centimetres to about 21 metres.

The north pole of balance lies at the centre of the Chandler Circle. Its position locates the north geographic pole. Each year since 1900, the north pole of balance has moved about 15 centimetres toward North America. This motion has caused tiny changes in the latitude and longitude of points around the earth.

The north magnetic pole is the point toward which north-seeking compass needles point. This pole can move many kilometres in a few years. In 1970, the north magnetic pole was located near Bathurst Island in northern Canada.

The geomagnetic north pole lies near Thule, Greenland. In the upper atmosphere, the earth's magnetic field points down toward this point.

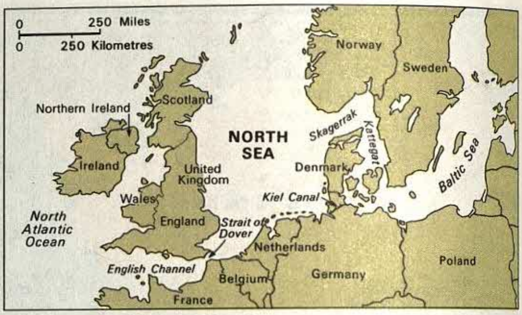
Related articles in ***World Book*** include:

Arctic (Arctic exploration)
Arctic Ocean (maps)
Bennett, Floyd
Byrd, Richard E.
Earth (The earth's magnetism)
Exploration (Polar exploration)
Henson, Matthew A.
Peary, Robert E.
Submarine (Nuclear submarines)

North Sea is a wide arm of the Atlantic Ocean that lies between the United Kingdom (UK) and the mainland of Europe. Seven nations—the UK, Norway, Denmark, Germany, the Netherlands, Belgium, and France—border on the sea. The North Sea is a major trade and transportation route. It is also an important source of petroleum, natural gas, and fish.

The North Sea covers 565,078 square kilometres. It extends almost 960 kilometres from north to south and about 580 kilometres from west to east. It has an average depth of 30 metres in the south and 120 metres in the north. The Strait of Dover and the English Channel connect the North Sea with the Atlantic Ocean. Skagerrak, an arm of the sea, links it with the Strait of Kattegat and the Baltic Sea. The Kiel Canal also connects the North and the Baltic seas.

Weather conditions in the North Sea are unpredictable, especially in winter. Winds of up to 160 kilometres an hour and severe storms sometimes occur, making navigation extremely dangerous.



Location of the North Sea

During the 1960's, vast amounts of petroleum and natural gas were found under the North Sea. Today, the United Kingdom and Norway get large quantities of petroleum from the area. Natural gas is piped ashore to the UK and Germany.

The fishing grounds of the North Sea rank among the richest in the world. They supply about 2.7 million metric tons of fish annually. Fish caught in the North Sea include cod, haddock, herring, mackerel, pilchard, plaice, sole, and whiting. The North Sea also provides many kinds of shellfish.

The North Sea is one of the world's most important waterways for commercial activity. Its many major ports include London, England; Hamburg, Germany; Amsterdam and Rotterdam, the Netherlands; Antwerp, Belgium; and Dunkerque, France.

The North Sea has been used for trade and transportation since ancient times. Its position made it important during World War I (1914-1918) and World War II (1939-1945). During World War I, the UK controlled the North Sea and prevented the German Navy from using it as a route to the Atlantic Ocean. During World War II, Germany controlled the part of the sea between Norway and France. But the UK controlled the English Channel and the northern approaches to the sea, allowing Allied ships to use the waterway.

The North Sea contains vast deposits of natural gas and petroleum. These reserves were discovered during the 1960's and belong mainly to the United Kingdom and Norway. They have become a major energy source for western Europe. This offshore oil rig is pumping petroleum from beneath the sea.

North Shropshire (pop. 52,400) is a local government district in Shropshire, England. Towns include Market Drayton, Ellesmere, and Whitchurch. Farmers in the area grow cereals and root crops and rear sheep and cattle. The district's products include cheese and cream, dairy equipment, eggs, sausages, iron and steel products, and women's clothing.

North Star is a readily visible star that appears to be located almost directly above the North Pole. The term *polestar* is sometimes used for North Star. The North Star is presently Polaris, the brightest star in the constellation Ursa Minor. Polaris is located within one degree of the place where the northern extension of the earth's axis pierces the sky. Because of its position, Polaris appears stationary, while other stars seem to revolve around the earth's axis as the earth rotates. As a result, Polaris has served as a guide for navigators through the centuries. Polaris is a star of the second *magnitude*. The brighter a star is, the lower is its magnitude (see **Star** [Measuring brightness]).

Polaris will not always be the North Star because the earth's axis will not always point toward Polaris. The earth's rotational axis changes direction in a circular motion called *precession*. Each end of the axis traces out a fictitious circle in the sky. One complete trip around the circle takes about 26,000 years. Thus, the brighter stars on or near the precessional circle above the earth's North Pole each become the North Star for a certain period. For example, in about 12,000 years, the earth's axis will point north to a spot near Vega in the constellation Lyra. In about 22,000 years, Thuban in the constellation Draco will become the North Star. About 26,000 years from now, Polaris will return to its present location relative to the earth's axis, and will be the North Star.

See also **Astronomy** (map: The stars and constellations of the Northern Hemisphere); **Star**.

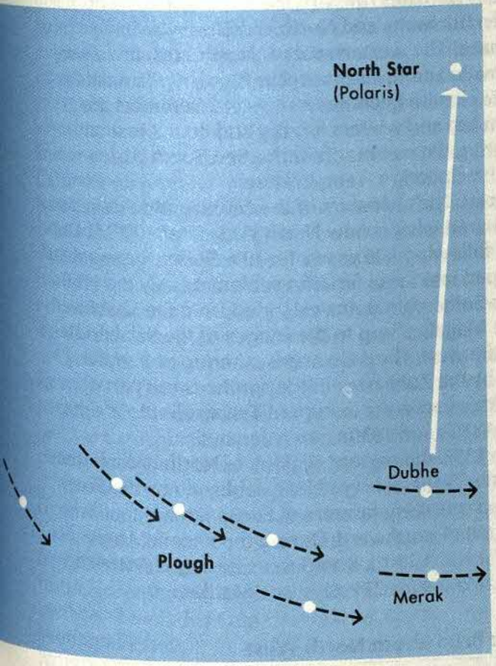
North Tyneside (pop. 188,800) is a local government district in Tyne and Wear, England, administered from the fishing port of North Shields. It includes the resorts of Cullercoats, Tynemouth, and Whitley Bay, and the eastern end of Hadrian's Wall.

North Vietnam. See **Vietnam.**

North Warwickshire (pop. 59,800) is a local government district in Warwickshire, England, administered from the market town of Atherstone. Agriculture is important in the rural areas. The district also has light industry—notably the manufacture of hats, boots, shoes, and knitwear—and coal mining.

North West is one of South Africa's nine provinces. It is bordered by Botswana to the north. The province came into being on April 27, 1994. It includes parts of the former Transvaal and Cape provinces and most of the former homeland of Bophuthatswana. The main cities and towns are Mmabatho, Mafikeng, Klerksdorp, Potchefstroom, and Rustenburg.

People. For North West's total population, see the



The North Star appears at the centre of circular tracks made by other stars in a time-exposure photograph, *right*. The earth's rotation on its axis makes other stars seem to rotate around the North Star, which lies near the axis. The North Star may be located by using the group of stars called the Plough, *above*. Two of these stars, Dubhe and Merak, are almost in line with the North Star.

Facts in brief table with this article. More than half the population live in rural areas, though many rural people began moving to cities and towns in the 1990's. There are marked differences in standards of living between the urban and rural areas. For example, many rural people lack schools and health care facilities. Tswana is the most commonly spoken language in North West, followed by Afrikaans, Xhosa, and South Sotho.

Government. Mmabatho, the former capital of Bophuthatswana, is the provincial capital of North West. The province has 17 seats in South Africa's National Assembly and 30 seats in the Provincial Legislature of elected representatives. A provincial premier heads a Cabinet of ministers who carry out the functions of the regional government.

Agriculture is a major economic activity in North West. The main farm products include maize, beef, sunflowers, wheat, sorghum, cotton, and peanuts. Many subsistence farmers also keep goats and sheep.

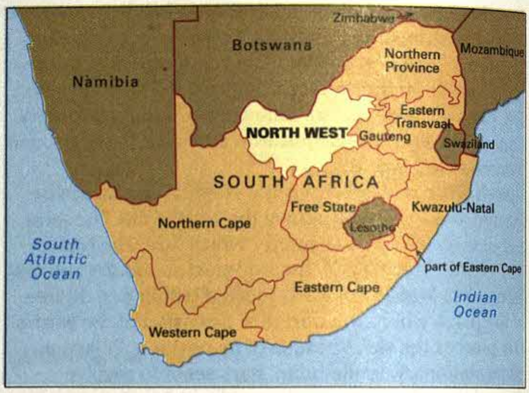
Manufacturing. Government incentives have attracted large industries to several industrial growth points in North West, especially to areas in the former Bophuthatswana. The three main industrial areas are Babalege, Garankuwa, and Mogwase. Manufactured products include car parts, furniture, and processed foods.

Mining. North West is rich in mineral deposits. More than half the province's economy is based on the mining industry, which employs a quarter of the labour force. North West is the world's largest producer of platinum. Other minerals and substances mined include asbestos, coal, chromium, copper, diamonds, fluorspar, gold, limestone, manganese, and nickel.

Tourism. The Sun City entertainment complex and nearby Pilanesberg National Park are North West's leading tourist attractions. Sun City provides employment and generates income for the province. Road and rail routes to Botswana pass through North West.

Land. The greatest portion of North West lies on the interior plateau of southern Africa, between 1,000 and 1,500 metres above sea level. Most of the province consists of vast, almost level plains. In the north, the remains of an ancient volcano form the Pilanesberg, which rises to 1,669 metres. The continental divide, the Witwatersrand (1,700 metres high), lies in the centre and east of North West. The Magaliesberg range, which rises to 1,700 metres, lies north of the Witwatersrand. The Ghaap plateau at a height of 1,300 metres lies in the southwest of the province. The vegetation of North West includes scrub, grassland, and woodland.

Sun City, *above,* in North West, is southern Africa's most popular tourist resort.



South Africa's North West province takes its name from its location within the nation.

Rivers. One of South Africa's most important rivers, the Vaal, forms the boundary between North West and Orange Free State. The Molopo River forms the border between Botswana and North West.

Climate. The western part of North West has a semiarid climate and droughts occur regularly. Toward the east, the climate becomes temperate. Summers are warm to hot and winters are dry and cold. Most rain falls during the summer months. See **South Africa** (maps: Precipitation, Temperature).

History. The ancestors of the Tswana and Sotho peoples entered what is now North West after 100 B.C. During the following 300 years, Tswana-Sotho communities developed into large farming settlements. By the 1700's, Tswana-Sotho chiefdoms extended from the Vaal River and the Magaliesberg to the fringes of the Kalahari Desert in the west. The *Mfecane* (scattering of people) waged by the Zulu army in the southeastern part of South Africa severely disrupted Tswana-Sotho life during the 1820's and 1830's (see **Mfecane**).

From 1852, the eastern regions of North West formed part of the Transvaal republic established by the *Boers* (Afrikaans-speaking farmers of European descent) who had migrated northward. During the Second Anglo-Boer War (1899-1902), Boer forces besieged Mafeking (now Mafikeng) for 271 days (see **Mafikeng**).

Facts in brief about North West

Population: *1994 estimate*—3,506,800.
Area: 118,710 km².
Languages: Tswana, Afrikaans, Xhosa, South Sotho.
Largest towns: Klerksdorp, Potchefstroom, Rustenburg, Lichtenburg.
Chief products: *Agriculture*—cattle, cotton, maize, sorghum, sunflowers, wheat. *Mining*—chromium, coal, copper, diamonds, gold, limestone, manganese, nickel, platinum, vanadium.

In 1913 and 1936, the Union of South Africa implemented Land Acts that forced many Sotho and Tswana people into reserves. Under *apartheid* (enforced ethnic separation), a Tswana territorial authority came into being in 1961 (see **Apartheid**). The Tswana territories were granted self government in 1972. In 1977, they became the fragmented homeland of Bophuthatswana (see **Bophuthatswana**). Lucas Mangope became Bophuthatswana's president. Many families were deprived of their South African citizenship and forcibly removed from their traditional lands to the homeland.

The South African government suppressed an attempted coup against President Mangope's regime in 1988. From 1991, Bophuthatswana participated in negotiations toward true democracy in a unified South Africa. However, Mangope opposed the reincorporation of Bophuthatswana in a new South Africa and formed an alliance with the white-dominated right-wing groups. Their support failed to save Mangope's government and, in 1994, he was forced to resign.

Bophuthatswana ceased to exist and North West province came into being on April 27, 1994, the first day of South Africa's first truly democratic general election. The African National Congress (ANC) won a majority in the new Provincial Legislature. Popo Molefe of the ANC became North West's first provincial premier.

See also **Mafikeng; Mmabatho; Transvaal; South Africa.**

North West Leicestershire (pop. 79,400) is a local government district in Leicestershire, England, administered from Coalville. Other places include Ashby de la Zouch, Castle Donington, and Ibstock. Agriculture and coal mining are important. Other industries in North West Leicestershire include quarrying granite and limestone, and making biscuits, bricks and pipes, footwear, knitwear, and pork products. East Midlands Airport is at Castle Donington.

North West Rebellion was a conflict that arose in 1885 between the *métis* (people of mixed white and Indian ancestry) and the Canadian government in what is now Saskatchewan. It resulted from métis fears that government plans to encourage new farming settlements in the northwest would threaten their communities.

Canada's government sent a military force to Saskatchewan. These troops, joined by the North-West Mounted Police and local volunteers, moved against the métis at Batoche. The métis, seriously outnumbered and poorly equipped, were defeated at Batoche in May 1885.

After the rebellion, people in the northwest gained representation in the Canadian Parliament. But the rebellion accomplished almost nothing for the métis.

North Wiltshire (pop. 109,600) is a local government district in Wiltshire, England, administered from Chippenham. It includes Calne, Cricklade, Malmesbury, and Wootton Bassett.

North Yemen. See **Yemen.**

North Yorkshire. See **Yorkshire.**

Northampton (pop. 178,200) is a town and local government district in Northamptonshire, England. It is a manufacturing centre, known for its footwear industry. The town stands on the River Nene. Fine buildings include St. Peter's Church, with its Norman decorations, and a modern Roman Catholic cathedral. Northampton was formerly a *new town* (see **New town**).

Northamptonshire is a small English county of beautiful stone-built villages, historic mansions, stately homes, and churches with fine medieval spires. The county is famous for footwear and clothing. The industrial towns lie near the centre of the county. The land varies from flat open meadows in the lower Nene Valley to soft rounded hills in the southwest.

In 1974, Northampton became part of the county for administrative purposes. Previously it had been separately administered as a county borough.

People and government

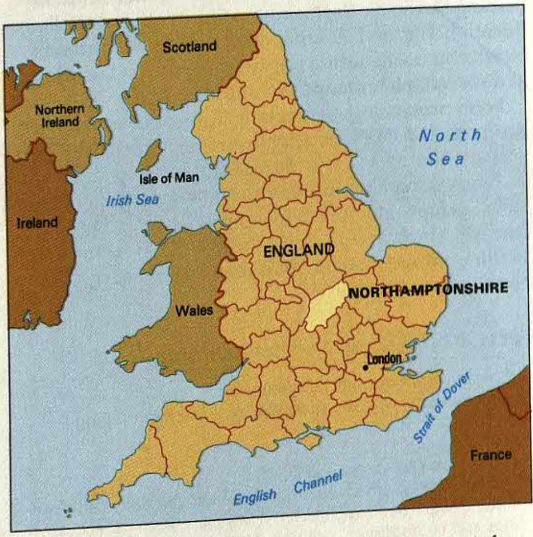
Local customs. Rothwell has had an annual charter fair since 1204. It starts on the day after Trinity Sunday and lasts one week. Corby's charter fair is held on Whit Monday every 20 years.

Recreation. Hunting is popular in Northamptonshire, which has several packs of hounds. Several stretches of forest areas, particularly Rockingham Forest, are popular for riding. Horse lovers can also watch racing at Towcester. Water sports, including canal cruising and fishing, are popular. International motor-racing events take place at Silverstone. Northamptonshire has a cricket team in the county championship. Northampton has a soccer team in the Football League.

Local government. The county is divided into seven local government districts: *Corby, Daventry, East Northamptonshire, Kettering, Northampton, South Northamptonshire,* and *Wellingborough.* Corby and Northampton were formerly new towns. Northamptonshire County Council, which has headquarters at Northampton, provides some public services throughout the county. The crown court sits at Northampton. The police force is the Northamptonshire Constabulary. It has its headquarters in Northampton.

Economy

Agriculture and mining. Farms cover more than five-sixths of the county. It has much grassland, on which beef and dairy cattle graze. Farmers grow some



Northamptonshire is bordered by six other counties. It is famous for the manufacture of clothes and footwear.

Rockingham is an attractive village near Corby in northeastern Northamptonshire.

cereals, particularly barley. Other crops include potatoes, sugar beet, other root crops, and oil seed rape.

A bed of iron ore runs from Northampton northeast to the middle of Lincolnshire, but ironstone is no longer quarried for steel making.

Manufacturing. The county is attracting many new industries, particularly in Corby and Northampton. Wellingborough has an enterprise zone, and both Kettering and Daventry have extensive industrial estates. Many of the men's shoes produced in the United Kingdom are made in the county. Associated industries include leather tanning and dyeing.

A number of towns have engineering industries, including Daventry, Northampton, Rushden, and Wellingborough. Lifts and lift equipment are manufactured in Northampton. Kettering has several clothing factories and research laboratories for the shoe trade.

Food processing, particularly the production of meat products, is a large industry in Northamptonshire. There is also a large brewery at Northampton.

Transportation and communication. Main railway lines linking London with the north of England pass through Northampton, and also through Kettering and Wellingborough. Some good roads pass through the county, including the M1.

Facts in brief about Northamptonshire

Administrative centre: Northampton.
Largest towns: Northampton, Corby, Kettering, Wellingborough.
Area: 2,365 km².
Population: *1991 census*—568,900.
Chief products: *Agriculture*—barley, beef and dairy cattle, potatoes, sugar beet, vegetables. *Manufacturing*—car accessories and components, clothing, engineering products, lift equipment, shoes, soap, steel tubing, telephone equipment.

Kettering and Northampton have daily newspapers, and the county has several weekly newspapers. Northampton has a BBC local radio station, and an independent station, Northants 96.

Land

Location and size. Northamptonshire is almost in the centre of England. The county is long, narrow, and irregular in shape, stretching for 95 kilometres from southwest to northeast. It measures 40 kilometres across at the widest point and borders on six other counties.

Land features. Arbury Hill, near Daventry, rises 224 metres above sea level. There are remains of ancient forests at Rockingham in the northeast and at Salcey and Whittlebury in the south.

The central geographical feature of Northamptonshire is the Nene Valley, a wide, shallow valley that separates two ridges of high ground. One ridge runs northwards to Stamford, Lincolnshire. The other lies between the Nene and the Ouse valleys. Picturesque stone-built villages lie in the Nene Valley.

Rivers and lakes. The Nene rises near Daventry and flows for about 100 kilometres within the county. At one time, the river often flooded causing great damage. But it is now one of the best managed rivers in England. The other important river, the Welland, rises near Naseby. The Welland forms much of the northern boundary.

Northamptonshire lakes are all artificial. Water-filled sand and gravel pits at Thrapston form a large lake used for sailing. People boat and swim at the Wicksteed pleasure-park at Kettering.

Climate is near the average for the UK. Rainfall averages 635 millimetres a year. January temperatures average 5° C. July temperatures average 18° C.

History

Many monarchs figure in the past of Northamptonshire. Northampton became important because of its central position in England. Henry I made the town a royal stronghold. His daughter Matilda was proclaimed Queen of England in Northampton's old church of All Saints. Henry II staged the trial of St. Thomas à Becket, archbishop of Canterbury, at the town. One of the men responsible for murdering Becket was a knight from Northampton.

King John visited Northampton several times. Henry VI lost his throne to Edward IV after he was beaten at the battle of Northampton. Richard III was born at Fotheringhay Castle. Mary, Queen of Scots, was executed at Fotheringhay Castle. Members of two Northamptonshire families, the Treshams and the Catesbys, took part in the Gunpowder Plot to blow up the Houses of Parliament when James I was present.

The most important national event to take place in the county was the defeat of Charles I by Cromwell at Naseby, which ended the first phase of the Civil War in 1646. The king fled after the battle and later surrendered to the Scots.

John Dryden, the poet, was born at Aldwincle All Saints. Charles Kingsley, the novelist, spent his early youth in the county.

Northamptonshire has produced good leather for hundreds of years. Big military orders, which began in the 1700's during the American War of Independence, first stimulated the shoe industry. When railways were built, shoemaking towns were able to send their goods to other towns throughout the United Kingdom. As a result, the industry grew rapidly.

People first noticed the large iron-ore deposits when the land was excavated for railway tunnels and cuttings. Thomas Butlin of Wellingborough made the first Northamptonshire pig iron in the 1850's.

Lace making was once a major manufacturing industry. More than 10,000 workers, mainly women and children, made lace in the 1800's.

Related articles in *World Book* include:

Dryden, John
Eleanor Crosses
Kings and queens of Britain and Ireland
Kingsley, Charles
Northampton
Ouse

Northavon (pop. 129,600) is a local government district in Avon, England, lying north of Bristol and Kingswood. It is widely rural, and arable farming is important in the area.

Northavon's industrial centres are at Yate, Filton, Patchway, and Thornbury. Factories making chemicals, including drugs, are at Pilning and Severnside. Filton and Patchway are important centres of the British aerospace industry. Oldbury has a nuclear power station.

Northcliffe, Viscount (1865-1922), a famous British journalist and publisher, pioneered in the use of comics, special features, religious news, and tabloid newspapers. He also played an important part in the formation in 1916 of the Coalition Cabinet led by David Lloyd George.

Northcliffe owned the Amalgamated Press, a large magazine publishing house, and the London *Evening News,* the *Daily Mail,* the *Daily Mirror,* and *The Times.* He was born in County Dublin, Ireland. Northcliffe's original name was Alfred Charles William Harmsworth. He was made a baron in 1905.

Northeast Passage. See **Arctic Ocean.**

Norther is a cold winter wind that sweeps over the southern United States and the Gulf of Mexico, destroying crops and wrecking ships. The northers occur most frequently between September and March. Northers often cause the temperature to drop rapidly as much as 11 to 17 degrees Celsius.

Northern Cape is South Africa's largest province, covering just under 30 per cent of the total area of the country. The province came into being on April 27, 1994. Northern Cape occupies most of the northwest of South Africa. It is bordered to the north by the countries of Namibia and Botswana and shares provincial borders with Western Cape, Eastern Cape, Free State, and North West. The main cities and towns are Kimberley, Upington, Prieska, and De Aar.

People. For Northern Cape's total population, see the *Facts in brief* table with this article. Afrikaans is the most widely spoken language. Other languages used by many people are Tswana, Xhosa, and English. Just over half of Northern Cape's population are people of mixed ancestry, about a third are of African descent, and about one-sixth are of European descent. South Africa's original inhabitants, the San, inhabited the region for thousands of years and a few still do so today (see **San**).

There are few towns in Northern Cape. Some settlements are isolated. The province has the lowest growth rate in South Africa because many young people move to other parts of the country.

Copper mining at Okiep, *above,* is important to the economy of South Africa's Northern Cape Province.

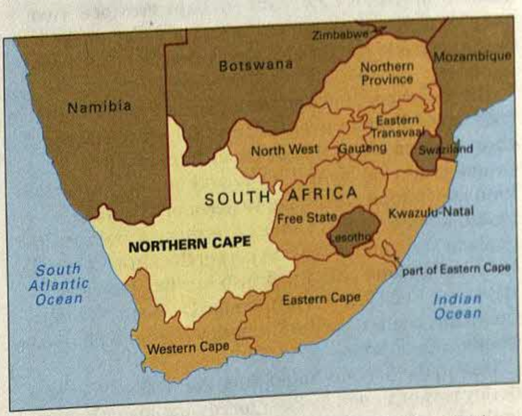
Government. Kimberley is the provincial capital of Northern Cape. The province has 15 seats in the National Assembly and 30 seats in the Provincial Legislature. A provincial premier heads a Cabinet of ministers who carry out the functions of the regional government.

Economy. Northern Cape has little industry and is of minor economic importance to South Africa. Mining and agriculture form the basis of the province's economy.

Mining. Large deposits of iron ore are mined at Sishen. Trains carry the ore 860 kilometres to Western Cape for export. Diamonds are mined along the Atlantic coast and in the Kimberley area. Asbestos, copper, lead, limestone, manganese, and zinc are also mined in the province.

Agriculture and fishing. Most agriculture in Northern Cape involves irrigation. Farm products include beans, dairy produce, lucerne, maize, and vegetables. Many farmers keep sheep and cattle. Port Nolloth on the Atlantic coast is a fishing and lobster port.

Tourism. Spectacular springtime displays of wildflowers attract many visitors to Namaqualand, a dry area along the coast, to the south of the Orange River. Other attractions include the Augrabies Falls, west of Upington, where the Orange River plunges 191 metres into a rocky gorge. The Kalahari Gemsbok National Park, on the border with Namibia and Botswana, is a haven for desert wildlife. See **Augrabies Falls; Namaqualand.**



Northern Cape, in northwestern South Africa, is the nation's largest province in area.

Facts in brief about Northern Cape

Population: *1994 estimate*—763,900.
Area: 363,389 km².
Languages: Afrikaans, Tswana, Xhosa, English.
Largest cities and towns: Kimberley, Upington, Prieska, De Aar.
Chief products: *Agriculture*—beans, cotton, dates, grapes, lucerne, maize. *Manufacturing*—asbestos, copper, diamonds, iron ore, lead, limestone, manganese, zinc.

Land. Northern Cape's coastline runs for 300-kilometres along the Atlantic Ocean. The narrow coastal plain is an arid, inhospitable area with sparse vegetation. The northeastern, central, and southern regions of Northern Cape lie on southern Africa's central plateau and form part of the semidesert region of the Great Karoo (see **Karoo**). Altitudes range from 1,000 metres to 1,500 metres above sea level. The north of the province is slightly lower, forming part of the depression of the Kalahari Desert. The province's western section drops in altitude toward the coast. Several mountain ranges form a rim along the province's southern boundary.

The Richtersveld is an area in the northwest, on the border with Namibia. Huge depressions, or *pans,* occur in the northwestern and central parts. They are usually dry and salt-coated.

Rivers. South Africa's longest river, the Orange, flows westward through the province, forming part of the Namibian border (see **Orange River**). The Molopo River forms part of the border with Botswana and may dry up in hot weather. Floods sometimes occur during the rainy season.

Climate. Northern Cape has two main climatic zones, the semiarid interior Karoo plateau and the arid coastal desert. Rainfall decreases from about 40 centimetres in the east to less than 5 centimetres in the west. Along the coast, it is cool and dry with frequent mist because of the influence of the cold Benguela current. See **South Africa** (maps: Precipitation, Temperature).

History. Khoisan hunter-gatherers and herders lived in the Northern Cape region for thousands of years before the arrival of European settlers in the 1600's. As the Cape Colony expanded during the 1700's, communities of displaced Khoisan, former slaves, and European settlers developed on the colony's western and northern borders, in what is now Northern Cape Province. Two peoples of mixed ancestry, the Bastaards (later called the Griqua) and the Orlams, developed from such communities.

The discovery of diamonds in the Kimberley district in 1869 led to disputes over land. In 1871, an arbitration court granted ownership of the diamond fields to a Griqua group led by Andries Waterboer. For protection from the Orange Free State, Waterboer asked the United Kingdom (UK) to annex a territory known as Griqualand West and it became part of the Cape Colony in 1880. In the same year, the British businessman and statesman Cecil Rhodes formed the De Beers Mining Company, centred on the Kimberley diamond fields (see **Rhodes, Cecil John**).

During the Second Anglo-Boer War (1899-1902), Kimberley was besieged by Boer forces and major battles took place along the region's main railway line and at Magersfontein. During the 1900's, the descendants of the Khoisan and Griqua lost much of their land under South Africa's system of enforced ethnic separation known as *apartheid* (see **Apartheid**).

Northern Cape remained a region of Cape Province until April 27, 1994, when it became one of nine new provinces on the first day of South Africa's first truly democratic election. The African National Congress (ANC) won a majority in the new provincial assembly. Manne Dipico of the ANC became Northern Cape's first provincial premier.

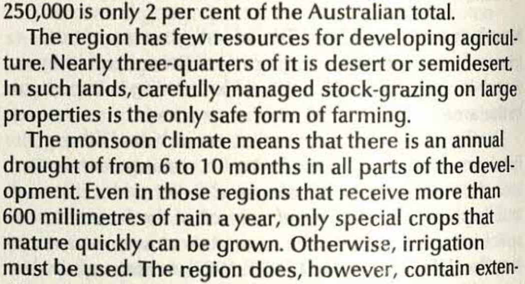
See also **Cape Province; Kimberley; South Africa.**

Northern development in Australia includes all land north of the South Australian border except for the sugar coast of Queensland. The region occupies 54 per cent of the area of Australia. But its population of 250,000 is only 2 per cent of the Australian total.

The region has few resources for developing agriculture. Nearly three-quarters of it is desert or semidesert. In such lands, carefully managed stock-grazing on large properties is the only safe form of farming.

The monsoon climate means that there is an annual drought of from 6 to 10 months in all parts of the development. Even in those regions that receive more than 600 millimetres of rain a year, only special crops that mature quickly can be grown. Otherwise, irrigation must be used. The region does, however, contain extensive mineral resources.

In the 80 years before World War II ended in 1945, development of northern Australia had been extremely slow. It consisted mainly of extensive beef-cattle grazing, plus a few scattered mining centres. The threat of invasion by the Japanese during World War II gave rise to a demand by many Australians to improve road and air transport in the area and to develop these vast empty lands. The development would improve security and make the region easier to defend.



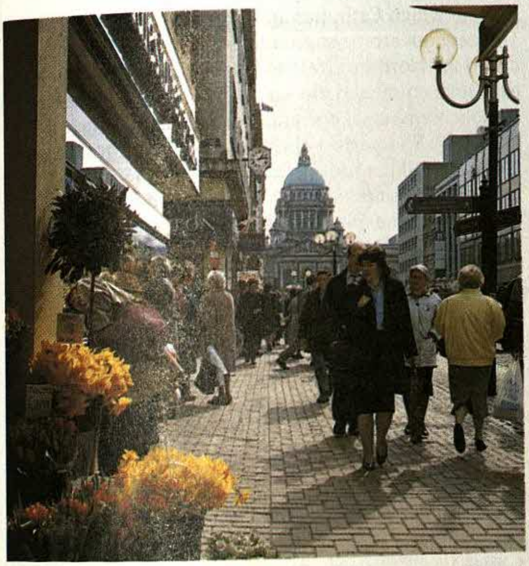
Northern development (within the thick dashed line) concerns the sparsely populated northern part of Australia. It excludes the fairly developed sugar-growing area of coastal Queensland.

A number of large crop-farming ventures in northern Australia were attempted in the 1960's and 1970's. However, all of these attempts failed.

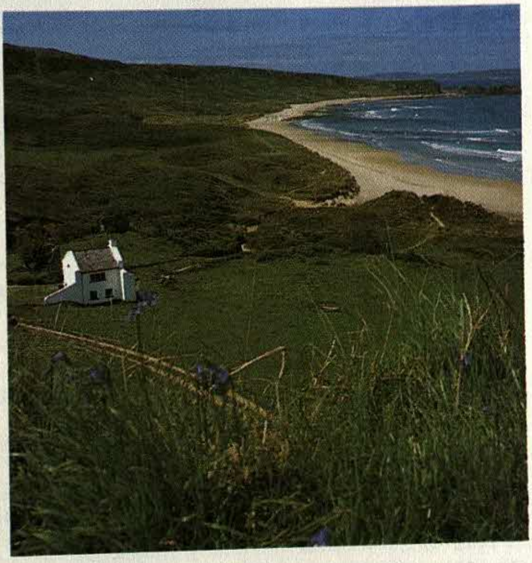
During the 1960's and early 1970's, the discovery and development of several huge, rich mineral deposits in the northern region changed the pattern of development dramatically. These mineral deposits include iron ore in the Pilbara District and bauxite at Weipa and Gove.

See also **Northern Territory** and **Western Australia.**

Northern Hemisphere. See **Hemisphere.**



Belfast is the capital and largest city of Northern Ireland. Donegall Place, in the heart of Belfast, *above,* features an outdoor precinct lined with shops and offices.



The landscape of Northern Ireland has many fertile, rolling plains inland and low mountains near the coast. The mountains slope down to a beach along part of the northern coast, *above.*

Northern Ireland

Northern Ireland is the smallest of the four major political divisions that make up the United Kingdom of Great Britain and Northern Ireland, often shortened to Britain or the United Kingdom (UK). The other divisions that make up the United Kingdom are England, Scotland, and Wales, which are part of the island of Great Britain. Belfast is Northern Ireland's capital and largest city.

Northern Ireland occupies the northeastern corner of the island of Ireland. It takes up about a sixth of the island. The independent Republic of Ireland occupies the rest of the island. Northern Ireland is often called *Ulster.* Ulster was the name of a large province of Ireland until 1920, when Northern Ireland was separated from the rest of Ireland. The old province of Ulster consisted of nine counties. In 1922, six of these counties chose to remain part of the United Kingdom when the Irish Free State was formed. The six became Northern Ireland. Although it is considered one of the countries forming the United Kingdom, Northern Ireland is also often called a UK province.

Religion has long divided the people of Northern Ireland into rival political, social, and cultural groups. The majority of Northern Ireland's people are Protestants, and they have traditional ties to the rest of the United Kingdom. Nearly all the rest of the inhabitants are Roman Catholics, as are most of the people in the Republic of Ireland to the south. In general, Protestants want Northern Ireland to remain in the United Kingdom, and Catholics want it to become part of the Irish Republic. The continuing dispute between the two groups has sometimes led to riots, bombings, and other outbreaks of violence and terrorism, often called *the troubles.*

This article tells about the people, geography, economy, and history of Northern Ireland. For a discussion of the United Kingdom as a whole and of Northern Ireland's relation to the other political divisions, see **United Kingdom.** For information on the Republic of Ireland, see **Ireland.**

Government

Northern Ireland is part of the United Kingdom, a constitutional monarchy. Queen Elizabeth II is the head of state, but a Cabinet of government officials called *ministers* actually rules the UK. The *prime minister* is the chief ruling official. *Parliament* makes the laws of the United Kingdom. Parliament includes the *House of Commons* and the *House of Lords.* Northern Ireland elects 17 members of the House of Commons. Most members of the House of Lords are nobles who inherit their seats. Other members of the lords include people who are appointed for their service to the United Kingdom. For

Facts in brief about Northern Ireland

Capital: Belfast.

Official language: English.

Area: 14,144 km². *Greatest distances*—east-west, 179 km; north-south, 137 km. *Coastline*—531 km.

Elevation: *Highest*—Slieve Donard, 852 m above sea level. *Lowest*—The Marsh, near Downpatrick, 0.4 m below sea level.

Population: *Estimated 1996 population*—1,642,000; density, 116 people per km²; distribution, 70 per cent urban, 30 per cent rural. *1991 census*—1,578,000. *Estimated 2001 population*—1,667,000.

Chief products: *Agriculture*—cattle, chickens, eggs, pigs, sheep, milk, potatoes. *Manufacturing*—aircraft, car parts, chemicals, computer chips, Irish linen and other textiles, machinery, processed foods, ships.

Money: *Currency unit*—pound sterling. One pound = 100 pence.

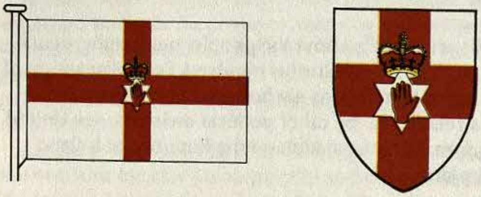
more information on the UK government, see **United Kingdom, Government of the.**

Central government. Until 1972, Northern Ireland was the only British country with its own governor, parliament, prime minister, and cabinet. The governor served as the official head of state, but the prime minister and cabinet actually held most of the governing power. Northern Ireland's two-house Parliament handled such matters as maintaining law and order, administering the educational system, and regulating commerce and agriculture. Certain other powers, such as levying income taxes and maintaining armed forces, were reserved for the Parliament of the UK. Throughout the history of Northern Ireland, the Unionist Party, a Protestant group, controlled the government.

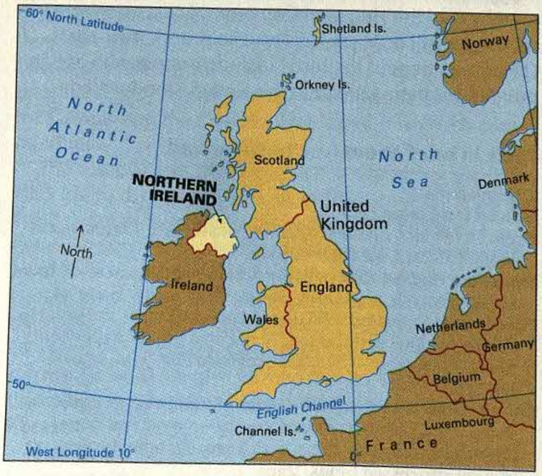
During the late 1960's and early 1970's, disagreements between Catholics and Protestants in Northern Ireland erupted in violent disorders. The Catholics demanded various reforms, including more political power. The continuing conflict led the UK government to suspend Northern Ireland's government in March 1972, and to establish direct rule over the country. The UK government appointed a Secretary of State for Northern Ireland to take over executive and legislative powers.

In 1973, agreement was reached on a new government in which Catholics and Protestants shared power. The new government included a 78-member legislature, called the Northern Ireland Assembly, and a 15-member executive council made up of Catholic and Protestant assembly members. Legislative elections were held in June 1973. The period of direct rule by the government of the United Kingdom ended on Jan. 1, 1974, when the new executive council took office. Brian Faulkner, who had been prime minister before the British take-over, became head of the council.

But Catholic and Protestant extremist groups opposed the power-sharing government. Terrorism by the pro-Catholic Irish Republican Army (IRA) and by Protestant groups took place. In May 1974, Protestants led a general strike that severely disrupted the economy of Northern Ireland. The strike led to the resignation of the executive council. The UK then suspended the Northern



Northern Ireland's flag and coat of arms have a six-pointed star and the ancient Ulster symbol of a red hand. The star and hand appear over the St. George's cross of the English flag. Northern Ireland's flag and coat of arms ceased to be official symbols after the UK took direct control of the country's government in 1972. The flag is often flown by private citizens, but the official flag has always been the British Union Flag.

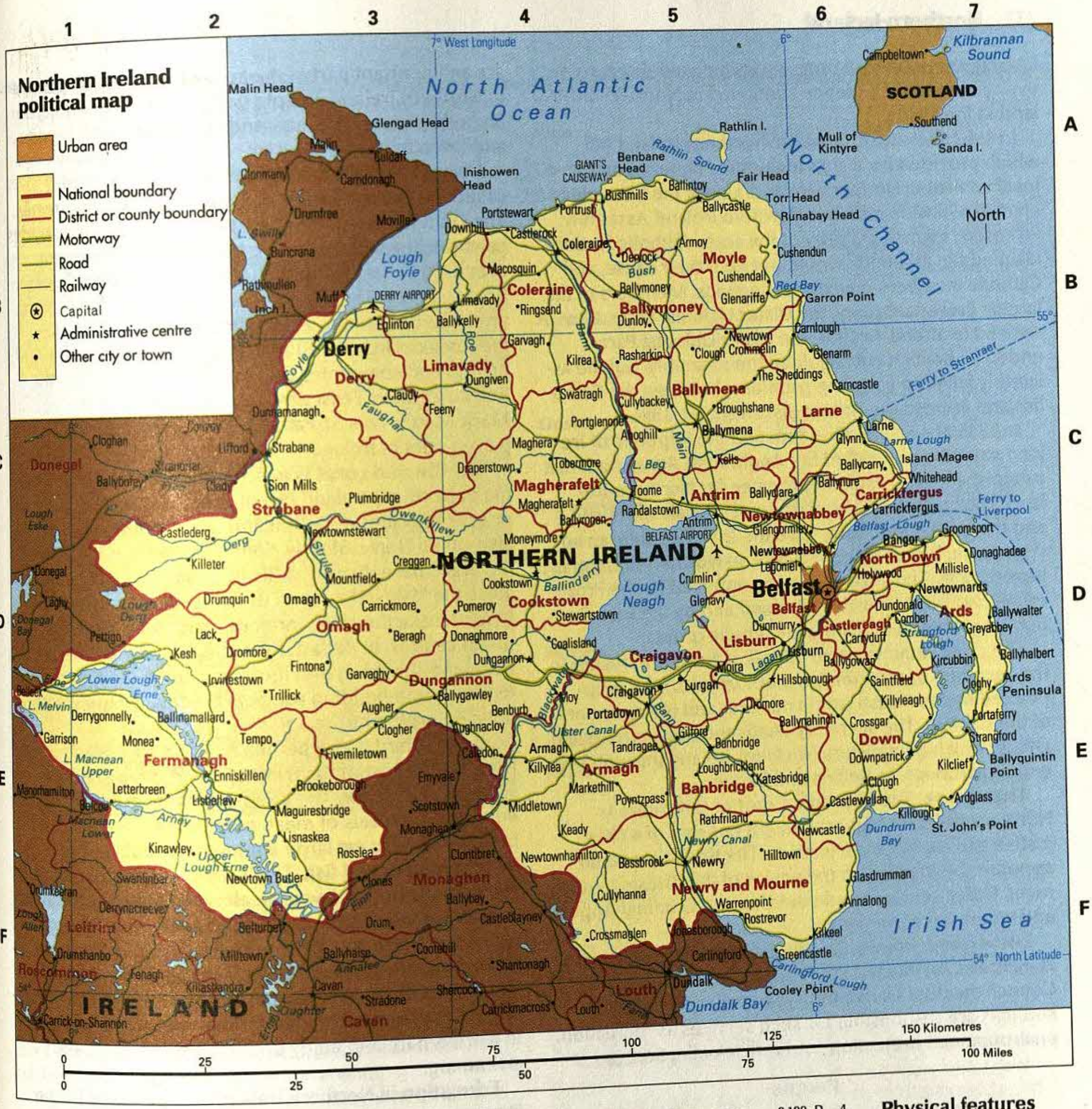


Northern Ireland occupies about a sixth of the island of Ireland. It is part of the United Kingdom.

Local government districts in Northern Ireland

District	Places contained*
Antrim	*Antrim,* Crumlin, Parkgate, Randalstown
Ards	Ballywalter, Comber, Donaghadee, Kircubbin, *Newtownards,* Portaferry
Armagh	*Armagh,* Keady, Markethill, Middletown, Tandragee
Ballymena	Ahogill, *Ballymena,* Broughshane, Newtown Crommelin, Portglenone
Ballymoney	*Ballymoney,* Dunloy, Rasharkin
Banbridge	*Banbridge,* Katesbridge, Loughbrickland
Belfast	*Belfast* (city), Legoniel
Carrickfergus	*Carrickfergus,* Whitehead
Castlereagh†	*Carryduff,* Dundonald
Coleraine	*Coleraine,* Downhill, Garvagh, Kilrea, Macosquin, Portrush, Portstewart, Ringsend
Cookstown	Ballyronan, *Cookstown,* Moneymore, Pomeroy, Stewartstown
Craigavon	Lurgan, *Portadown*
Derry	Eglinton, *Derry,* Newbuildings
Down	Ardglass, Ballynahinch, Clough, Crossgar, *Downpatrick,* Killyleagh, Newcastle, Strangford
Dungannon	Augher, Aughnacloy, Ballygawley, Benburb, Caledon, Clogher, Coalisland, Donaghmore, *Dungannon,* Fivemiletown, Moy
Fermanagh	Ballinamallard, Belcoo, Brookeborough, Drumcard, *Enniskillen,* Garrison, Irvinestown, Kesh, Kinawley, Letterbreen, Lisnaskea, Maguiresbridge, Newtownbutler, Rosslea, Tempo
Larne	Carncastle, Carnlough, Glenarm, *Larne*
Limavady	Dungiven, Feeny, *Limavady*
Lisburn	Ballinderry Upper, Dunmurry, Glenavy, *Hillsborough,* Lisburn, Moira
Magherafelt	Draperstown, Maghera, *Magherafelt,* Swatragh, Tobermore
Moyle	Armoy, *Ballycastle,* Bushmill, Cushendall Cushendun
Newry and Mourne	Crossmaglen, Cullyhanna, Hilltown, Kilkeel, *Newry,* Newtownhamilton, Rathfriland, Rostrevor, Warrenpoint
Newtownabbey	*Ballyclare,* Ballynure, Glengormley, Newtownabbey
North Down	*Bangor,* Groomsport, Holywood
Omagh	Beragh, Creggan, Dromore, Drumquin, Fintona, Garvaghy, Mountfield, *Omagh,* Trillick
Strabane	Castlederg, Killeter, Newtownstewart, Plumbridge, Sion Mills, *Strabane*

*Names printed in *italics* are those of the administrative centres for the districts concerned.
†District council offices are in Belfast.



Northern Ireland map index

Districts of Northern Ireland

Map key	Name	Population	Area In km²	Administrative centre
C 5	Antrim	44,264	415	Antrim
D 7	Ards	64,006	368	Newtownards
E 4	Armagh	51,287	667	Armagh
C 5	Ballymena	55,916	634	Ballymena
B 5	Ballymoney	24,080	417	Ballymoney
E 5	Banbridge	33,144	442	Banbridge
D 6	Belfast	280,972	111	Belfast
C 6	Carrickfergus	32,299	848	Carrickfergus
D 6	Castlereagh	60,720	843	Belfast
B 4	Coleraine	51,060	478	Coleraine
D 4	Cookstown	30,883	512	Cookstown
D 5	Craigavon	74,350	279	Craigavon
C 3	Derry (Londonderry)	94,721	373	Derry
E 6	Down	57,503	638	Downpatrick
D 3	Dungannon	45,408	763	Dungannon
E 2	Fermanagh	54,290	1,700	Enniskillen
C 6	Larne	29,280	337	Larne
B 3	Limavady	29,144	585	Limavady
D 5	Lisburn	98,826	436	Lisburn
C 4	Magherafelt	35,884	562	Magherafelt
B 5	Moyle	14,635	494	Ballycastle
F 5	Newry and Mourne	82,237	886	Newry
C 6	Newtownabbey	73,718	160	Newtownabbey
D 6	North Down	70,065	733	Bangor
D 3	Omagh	45,068	1,124	Omagh
C 2	Strabane	35,711	861	Strabane

Source: 1991 census

All districts shown here are the subject of a separate article in *World Book*

Cities and towns

Annalong	2,659	F	6
Antrim	8,351	C	5
Armagh	13,606	E	4
Aughnacloy	1,921	E	3
Ballycastle	2,899	A	5
Ballyclare	5,819	C	6
Ballygawley	2,134	E	3
Ballymena	23,386	C	5
Ballymoney	5,697	B	5
Ballynahinch	2,521	E	6
Banbridge	7,968	E	5
Bangor	35,260	D	7
Bangor Castle	2,637		
Belfast	280,972	D	6
Bessbrook	2,951	F	5
Brookeborough	2,200	C	2
Bushmills	851	A	5
Carrickfergus	16,603	C	6
Carryduff	4,640	D	6
Castlederg	2,642	C	2
Castlewellan	2,468	E	6
Claudy	2,492	C	3
Clogher	1,748	E	3
Coalisland	4,228	D	4
Coleraine	16,354	B	4
Comber	5,575	D	6
Cookstown	6,695	D	4
Craigavon	12,594	E	5
Creggan	2,440	D	3
Crossmaglen	2,401	F	4
Crumlin	2,837	D	5
Cushendall		B	6
Derry	66,645	B	3
Donaghadee	5,662	D	7
Downpatrick	7,918	E	7
Dromore (Banbridge)	4,471	E	5
Dromore (Omagh)	2,221	D	2
Dundonald		D	6
Dungannon	8,190	D	4
Dunmurry	3,533	D	6
Enniskillen	9,769	E	2
Fivemiletown	1,932	E	3
Glengormley	2,566	D	6
Hillsborough	3,370	D	6
Holywood	5,273	D	6
Keady	2,432	E	6
Kells	2,490	C	5
Kilkeel	5,408	F	6
Killylea	2,316	E	3
Killyleagh	2,355	E	7
Larne	18,482	C	6
Legoniel	5,493	D	6
Limavady	6,004	B	4
Lisburn	31,386	D	6
Lisnakea	2,678	E	3
Lurgan	25,431	E	5
Maghera	2,343	C	4
Magherafelt	4,704	C	4
Moneymore	1,852	D	4
Newcastle	4,647	E	6
Newry	20,279	F	5
Newtown Butler	2,276	F	2
Newtownabbey	58,114	D	6
Newtownards	15,484	D	7
Newtownhamilton	2,567	F	4
Newtownstewart	2,223	C	2
Omagh	14,594	D	3
Pomeroy	1,705	D	4
Portadown	22,207	E	5
Portrush	2,408	B	4
Portstewart	2,539	B	4
Randalstown	2,024	C	5
Rosslea	2,187	E	3
Stewartstown	1,659	D	4
Strabane	9,413	C	2
Strangford	1,101	E	7
Warrenpoint	4,291	F	5
Whitehead	1,790	C	6

Physical features

Ards Peninsula	E	7
Arney, River	E	2
Ballinderry, River	D	4
Ballyquintin Point	E	7
Bann, River	B	4
Belfast Lough	D	6
Benbane Head	A	5
Blackwater, River	E	4
Bush, River	B	5
Carlingford Lough	F	6
Derg, River	C	2
Dundrum Bay	E	6
Erne, River	D	1
Fair Head	A	6
Foyle, River	B	2
Garron Point	B	6
Giants Causeway	A	5
Lagan, River	D	6
Larne Lough	C	6
Lough Beg	C	5
Lough Erne (Lower)	D	1
Lough Erne (Upper)	E	2
Lough Foyle	B	3
Lough Macnean	E	1
Lough Melvin	E	1
Lough Neagh	D	5
Magee, Island	C	7
Main, River	C	5
North Channel	A	6
Owenkillew, River	C	3
Rathlin Sound	A	5
Red Bay	B	6
Roe, River	B	4
Runabay Head	B	6
St. John's Point	E	7
Strangford Lough	D	7
Strule, River	D	3
Torr Head	A	6

Ireland Assembly and once again imposed direct rule over the country. Violence continued in Northern Ireland in the 1980's.

In 1982, Britain adopted the Northern Ireland Bill, which provided for a step toward the resumption of local control in Northern Ireland. Under the bill, voters elected a new 78-member Northern Ireland Assembly. Protestants won a majority of the seats. Catholic leaders claimed the assembly would not help their cause, and Catholic members boycotted meetings. Members of the largest Protestant party, the Ulster Unionist Party, also refused to attend. In 1984, the Ulster Unionist Party ended its boycott and rejoined the assembly. But the assembly failed to solve the problems between the Catholics and Protestants. Britain dissolved it in 1986.

In 1985, the United Kingdom and the Republic of Ireland signed a pact called the Anglo-Irish Agreement that established an advisory conference for Northern Ireland. The conference, consisting of officials of Ireland and the United Kingdom, gave the Irish Republic an advisory role, but no direct powers, in Northern Ireland's government. The agreement was opposed by the Protestant majority in Northern Ireland and by the Irish Republican Army, a militant pro-Catholic group.

The chief administrative official of Northern Ireland is the *secretary of state for Northern Ireland,* who is appointed by the British prime minister and is a member of the Cabinet. The secretary heads the Northern Ireland Office, which administers Northern Ireland through several departments in Belfast and Bangor.

The courts. The Supreme Court of Judicature is Northern Ireland's highest court. It consists of a chief justice and six associate justices. The British monarch appoints the justices on the advice of the British government. Other courts include the Court of Criminal Appeal and county and civil courts.

Local government. Northern Ireland is divided into 26 districts. An elected council governs each district. Council members serve four-year terms. The district councils are responsible for such services as recreation, environmental protection, and refuse collection.

People

Population. For Northern Ireland's total population, see the *Facts in brief* table with this article. About two-thirds of the people live in urban areas. The largest cities are Belfast and Londonderry.

Ancestry. A majority of the people who live in Northern Ireland are descended from English and Scottish settlers who arrived there since the 1600's. Most of the rest trace their ancestry to the earlier Celtic, Viking, and Norman settlers of the island of Ireland.

Language. English is the official language of Northern Ireland, and all the people there speak it. The Irish language, a form of Gaelic once used throughout Ireland, is taught to children in Roman Catholic schools and in some Protestant schools.

Way of life

Most people in Northern Ireland have a way of life similar to that of people in the rest of the United Kingdom. Many people in Northern Ireland relax in the evening by watching television. Films are also popular. As in the rest of the United Kingdom, *pubs* (public houses) are an important part of the social lives of many people in Northern Ireland. People gather in pubs to drink beer and other beverages, eat sandwiches, talk with friends, and listen to music.

Many Protestant men belong to an organization called the Orange Order and are known as *Orangemen.* The Orangemen hold parades every July 12. The parades celebrate the victory of King William III, a Protestant, over King James II, a Roman Catholic, in the Battle of the Boyne in 1690. The "Twelfth" is a public holiday in Northern Ireland. A similar association of Roman Catholics, the Ancient Order of Hibernians, holds parades on August 15 and sometimes on March 17. August 15 is the Roman Catholic Feast of the Assumption of the Virgin Mary. March 17 is St. Patrick's Day. Saint Patrick is the patron saint of Ireland.

City life and rural life. About two-thirds of the people of Northern Ireland live in urban areas. Many live in or near the cities of Belfast and Londonderry, which is also called Derry. Bloody rioting and numerous acts of terrorism have disrupted life in Belfast and Londonderry since the 1960's. However, British government aid has helped make the cities modern—and more peaceful—urban centres. In Belfast, for example, new hotels, offices, and shopping precincts have been built, and extensive home-building projects have eased the worst housing problems.

About a third of the people of Northern Ireland live in rural areas. Most of them earn their living by farming.

Food and drink. The people of Northern Ireland enjoy simple meals of meat, potatoes, vegetables, and bread. They also eat large amounts of poultry, eggs, dairy products, and fish. Tea is the most popular drink in Northern Ireland. A favourite alcoholic beverage is beer.

Recreation. Northern Ireland's most popular organized sport is soccer. Other popular sports in Northern Ireland include cricket; *Gaelic football,* which resembles soccer; handball; *hurling* and *camogie,* which are somewhat similar to hockey; and Rugby Union. Many people in Northern Ireland enjoy boating, fishing, golf, and swimming.

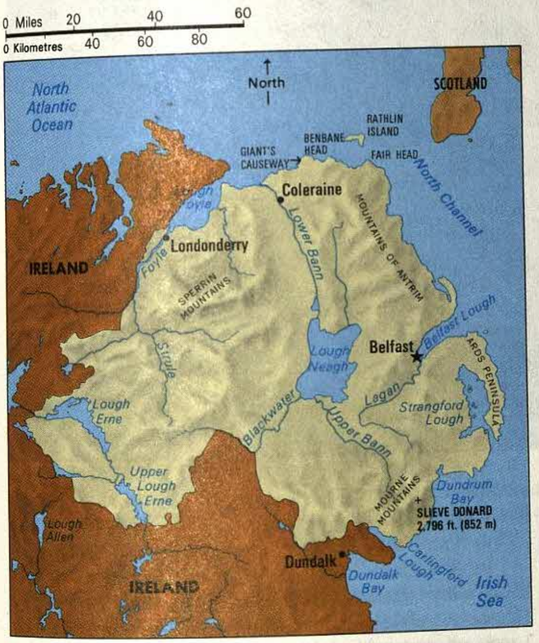
Education in Northern Ireland is supervised by the Department of Education for Northern Ireland and by five *area education boards.* All children in Northern Ireland from age 4 to 16 are required to attend school. Nearly all of them go to schools supported by public funds. Children attend a primary school from age 4 to 11. Some then attend a secondary school, which provides general and vocational education, or a grammar school, which prepares students for higher education. Others attend a comprehensive school, which provides both secondary and grammar school courses. Catholics operate their own schools, so education in Northern Ireland is largely segregated along religious lines. However, some integrated schools have been established by Catholic and Protestant parents who are concerned about the continued segregation.

There are two universities in Northern Ireland. They are the Queen's University of Belfast and the University of Ulster, which has branches in Belfast, Coleraine, Jordanstown, and Londonderry.

Religion. About two-thirds of the people of Northern Ireland are Protestants. Most of the rest are Roman Catholics. The Church of Ireland and the Presbyterian

Physical map of Northern Ireland

A large plateau about 150 metres above sea level covers most of Northern Ireland. The surface is lower near the centre around Lough Neagh, the largest lake in the British Isles. The land rises gently in the mountains surrounding the plateau.



Church are the largest Protestant churches. The Church of Ireland belongs to the Anglican Communion, which also includes the Church of England and the Episcopal Church in the United States.

Arts. The most famous cultural event in Northern Ireland is the international arts festival hosted each November by the Queen's University of Belfast. This festival features musical performances, dramatic productions, art exhibits, films, lectures, and other events.

The Ulster Orchestra and Opera Northern Ireland, both of which perform in Belfast, are well known. In addition, several individuals from Northern Ireland have established international reputations in music. They include the flautist James Galway and the pianist Barry Douglas.

Northern Ireland is also known for talented writers. The poetry of Seamus Heaney and John Hewitt, the novels of Brian Moore, and the plays of Brian Friel have attracted many readers.

Land

Northern Ireland occupies the northeastern corner of the island of Ireland. It covers 14,144 square kilometres. On the south and west, it is bordered by the Republic of Ireland, which occupies the rest of the island. The North Channel separates Northern Ireland from Scotland to the northeast. The closest point in Scotland lies only 21 kilometres from Northern Ireland. The Irish Sea separates Northern Ireland from England to the southeast. For more information about the geography and climate of Northern Ireland, see *Land* and *Climate* sections of **United Kingdom.**

Counties and county boroughs in Northern Ireland until 1973*

Name	Area (sq. km)	Population†	Current industries and products**
Counties			
Antrim	2,845	353,417	Building materials, cigarettes, clothing, engineering, meat products, paper, poultry, telecommunications goods, textiles.
Armagh	1,266	131,441	Carpets, clothing, dairy foods, electrical goods, forklift trucks, meat products, paper goods, rubber goods, textiles.
Down	2,465	311,266	Carpets, clothing, dairy products, engineering, fish, meat products, shoes, textiles.
Fermanagh	1,851	49,902	China, dairy products, meat products, plastic mouldings, yarn.
Londonderry	2,074	130,556	Casual clothing, dairy products, electrical engineering, knitwear, meat products, shirts, textiles.
Tyrone	3,265	137,997	Building materials, clothing, dairy products, glassware, hosiery, meat products, textiles.
County boroughs			
Belfast	62	358,991	Baking, brewing, carpets, cement, clothing, dairy products, engineering, fertilizers, printing, shipbuilding, textile machinery, textiles.
Londonderry	9	51,617	Casual clothing, shirts, light engineering.

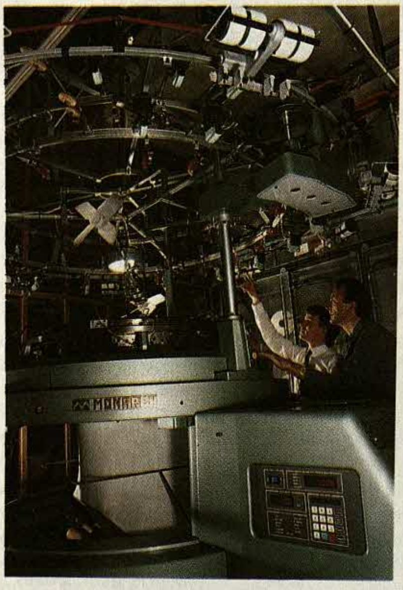
*Counties and county boroughs were replaced by *districts* in 1973. Since then, counties have existed only in postal addresses.
†Source: Registrar-General's estimates for 1971. Later figures for these areas not available.
**Source: Industrial Development Board for Northern Ireland, 1987.

Surface features. Northern Ireland is a land of rolling plains and low mountains. The plains, which cover the central part of the country, include fertile fields and pasturelands. The mountains, which are near the coast, have many deep, scenic valleys. In some areas, the plains reach to the coast.

The highest peak in Northern Ireland, 852-metre Slieve Donard, rises in the Mourne Mountains near the southeast coast. Other mountain ranges include the Sperrin Mountains in the northwest and the Mountains of Antrim in the northeast.

Lakes, rivers, and bays. Northern Ireland has many smooth, clear lakes called *loughs.* Lough Neagh, near the centre of the country, covers 396 square kilometres and is the largest lake in the British Isles (see **Lough Neagh**).

The largest river in Northern Ireland is the River Bann. The Bann actually is two rivers. The Upper Bann, which is 76.4 kilometres long, begins in the Mourne Mountains and flows northwestward into the southern end of Lough Neagh. The Lower Bann begins at the northern end of the lake and flows north 61 kilometres into the Atlantic Ocean. Many small, winding rivers empty into the Bann.



Industries in Northern Ireland draw on modern technology. In some factories, such as the one on the left, large machines spin fabrics from man-made elastic fibre. In a modern Ulster electronics factory, a technician visually checks a circuit board.

Several large bays, which are also called loughs, cut into the coast. Lough Foyle and Belfast Lough provide excellent harbours for Londonderry and Belfast.

Economy

Service industries are the leading employers in Northern Ireland. Major service industries there include education, government services, and health care.

Manufacturing. One of Northern Ireland's most famous manufactured products is Irish linen, which is known for its excellent quality. Most linen mills are near Belfast and Londonderry. Other mills in Northern Ireland produce woollen and cotton textiles and synthetic fibres. Beautiful pottery and hand-cut crystal are also made in Northern Ireland. The village of Belleek in the district of Fermanagh is famous for its delicate china.

Shipyards in the Belfast area have built many warships, ocean liners, and tankers. Aircraft plants in the area make commercial and military planes. Other products manufactured in Northern Ireland include car parts, chemicals, computer chips, processed foods, and videocassette recorders.

Agriculture and fishing. Cattle, chickens, eggs, pigs, milk, potatoes, and sheep are among Northern Ireland's most important agricultural products. Much barley and hay are grown for animal feed. Other farm products include butter, cheese, mushrooms, and turnips. Orchards in the district of Armagh produce apples, pears, and plums.

The fishing fleet of Northern Ireland brings in large catches of cod, herring, mackerel, shrimp, and whiting, mainly from the Irish Sea. Salmon and trout are netted in the rivers Foyle and Bann.

Transportation and communication. An excellent road system crisscrosses Northern Ireland. A government-operated railway system links Belfast and Londonderry with each other, with Portadown and Bangor in Northern Ireland, and with Dublin in the Irish Republic. Large amounts of freight pass through the seaports of Belfast, Coleraine, Larne, Londonderry, and Warrenpoint. Regular passenger ferry service connects Belfast and Larne with cities in western Scotland. Belfast International Airport is the only airport in Northern Ireland that handles international flights.

Northern Ireland has three daily newspapers, all published in Belfast. They are the *Belfast Telegraph,* the *Irish News,* and the *News Letter.* Two British Broadcasting Corporation television channels and two independent channels serve Northern Ireland.

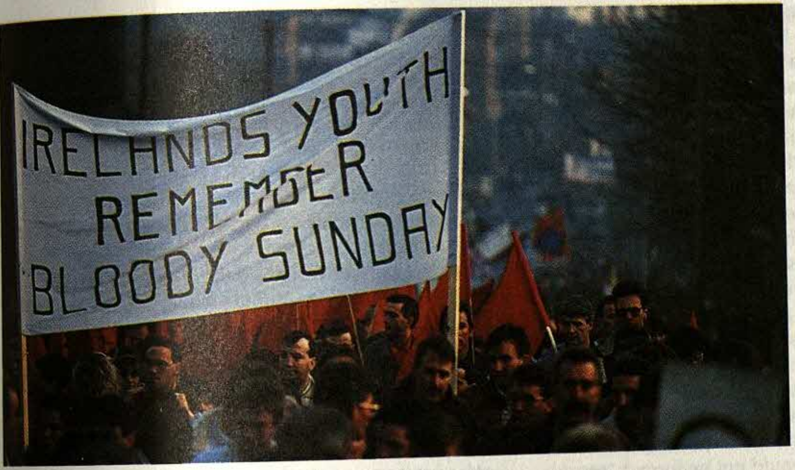
History

This section deals mainly with events in the history of Northern Ireland from Protestant settlement in the region in the 1600's to recent political developments. For information on the early history of the island of Ireland, see **Ireland, History of.**

Protestant settlement. In 1541, King Henry VIII of England became king of Ireland. The Reformation, during which Henry changed England from a Roman Catholic to a Protestant nation, had little effect on Ireland. English rule there was ineffective, and most Irish people remained Catholics.

In 1607, local Irish chieftains who opposed the English fled from Ulster, a large province in northern Ireland. King James I of England then gave the chieftains' land to English and Scottish Protestants. This action was partly responsible for the Protestant majority found in Northern Ireland today.

In the 1600's, two attempts were made to reestablish Catholic power in Ireland. The first was an uprising that began in 1641 and was not put down by English forces until 1653.



A demonstration in Londonderry, *left,* marks the anniversary of one of a series of bloody incidents—often called *the troubles*—in Northern Ireland's recent history. One of Northern Ireland's major problems is this ongoing, and sometimes deadly, political dispute between Roman Catholics and Protestants.

The second attempt was made under James II, a Catholic who became king of England in 1685. Many English people were unhappy with James's policies and feared that a Catholic succession to the throne would be established. In 1688, the English invited William of Orange, a Protestant, to invade England with Dutch forces. James fled, and William of Orange was crowned as King William III in 1689. Meanwhile, James went to France and then to Ireland, where he organized an army to fight William. But James was defeated by William in the Battle of the Boyne in 1690. After the battle, Anglican Protestants owned most of the land in Ireland, controlled Ireland's Parliament, and restricted the rights of Catholics and Presbyterian Protestants alike.

Union with Britain. In 1801, the Act of Union took effect. This act abolished the Irish Parliament and created the United Kingdom of Great Britain and Ireland. During the 1800's, the standard of living in northern Ireland rose as manufacturing flourished. But southern Ireland, where most of the Catholics lived, had a low living standard due to unequal distribution of land and a growing population.

In 1886, the British Liberal Party proposed a plan for Ireland called *home rule.* Under this plan, Ireland would have remained part of the United Kingdom, but it would have had its own parliament for domestic affairs. Ulster Protestants, who feared that such a parliament would be Catholic, opposed the plan. The plan was defeated in the British Parliament.

The division of Ireland. By the early 1900's, most Irish Catholics favoured complete independence from Britain. But most of the Protestants in Ulster opposed independence because they did not want to be a minority in a Catholic country. In 1919, 73 Irish members of the British Parliament met in Dublin and declared all Ireland an independent state. Guerrilla warfare then broke out between the Irish rebels and British forces.

In 1920, the British Parliament passed the Government of Ireland Act. This act divided Ireland into two separate political units and gave each some powers of self-government. Ulster Protestants accepted the act, and the state of Northern Ireland was formed from six counties in Ulster. But southern Catholics rejected the act and demanded complete independence for a single, united Irish republic. In 1921, southern leaders and the United Kingdom signed a treaty that created the Irish Free State from 23 southern counties and 3 counties of Ulster. In 1937, the Irish Free State changed its name to Eire. In 1949, Eire cut all ties with the United Kingdom and became the independent Republic of Ireland.

Under the 1920 act, Northern Ireland was given its own governor, parliament, prime minister, and cabinet. The governor served as the official head of state, but the prime minister and cabinet held most of the power. Northern Ireland's two-house Parliament handled such matters as administering the educational system and regulating commerce and agriculture. Certain other powers, such as levying income taxes and maintaining armed forces, were reserved for the British Parliament. Throughout Northern Ireland's period of self-rule, the Unionist Party—which favoured continued union with the United Kingdom—controlled the government.

Problems of division. Many Roman Catholics in Northern Ireland refused to accept the 1920 division of Ireland, and the new government made little effort to win their loyalty. In some areas where Catholics formed a majority, election districts were set up to ensure that Unionist minorities won control of local councils.

The division of Ireland was also opposed by the Irish Free State and, later, by Eire and by the Republic of Ireland. Beginning in 1921, armed groups crossed into Northern Ireland and attacked British government installations. The raiders hoped to force the British to give up control of Northern Ireland.

The civil rights movement. Catholics in Northern Ireland had long claimed that Protestants violated their civil rights and discriminated against them in jobs, housing, and other areas. When the government tried to stop a civil rights demonstration in Londonderry in 1968, bloody riots broke out. Serious riots occurred again in 1969 in Belfast and Londonderry. Troops were sent to Northern Ireland to restore order but failed to prevent further rioting. Meanwhile, the pro-Catholic Irish Republican Army (IRA) and other militant groups carried out bombings and other terrorist attacks.

The continuing conflict led the British government to suspend Northern Ireland's government in 1972 and to rule the region directly from London. But the troubles continued. In 1973 and 1982, the United Kingdom set up assemblies in Northern Ireland that were designed to restore control over local affairs to the region. However, lack of cooperation between Protestants and Catholics led the British government to dissolve both assemblies.

In 1985, the United Kingdom and the Republic of Ireland signed the Anglo-Irish Agreement, which gave the government of the Irish Republic an advisory role in Northern Ireland's affairs. Both Unionists and the IRA strongly opposed the agreement.

During the late 1980's and early 1990's, terrorist bombings intensified in Northern Ireland and in mainland Britain. The attacks also spread to continental Europe, where British military personnel and their families were the main targets. These actions led to violent responses by Protestant terrorist groups.

In December 1993, a meeting was held between UK Prime Minister John Major and Ireland's Prime Minister Albert Reynolds. The meeting resulted in the *Anglo-Irish Joint Declaration on Northern Ireland.* The declaration stated that a unified Ireland would not be forced; Ireland relinquishes all claims to the north; the UK has neither economic nor territorial ambitions in the region; and *Sinn Féin* (the political wing of the IRA) could join peace negotiations if they renounced violence.

In August 1994, the IRA announced a complete cessation of violence. Loyalist paramilitaries also renounced violence in October 1994. Sinn Féin President Gerry Adams began talks with Albert Reynolds in September of that year, and met with UK government officials in December. The talks raised hopes of peace in Northern Ireland. See **Ireland, History of; United Kingdom, History of the.**

Related articles in *World Book* include:

Antrim
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Castlereagh
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Derry
Down
Dungannon
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Giant's Causeway
Ireland
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Lisburn
Londonderry
Lough Neagh
Magherafelt
Moyle
Newry and Mourne
Newtownabbey
North Down
Omagh
Patrick, Saint
Strabane
Ulster

Outline

- **I. Government**
  - A. Central government
  - B. The courts
  - C. Local government
- **II. People**
  - A. Population
  - B. Ancestry
  - C. Language
- **III. Way of life**
  - A. City life and rural life
  - B. Food and drink
  - C. Recreation
  - D. Education
  - E. Religion
  - F. Arts
- **IV. Land**
  - A. Surface features
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- **V. Economy**
  - A. Service industries
  - B. Manufacturing
  - C. Agriculture and fishing
  - D. Transportation and communication
- **VI. History**

Questions

What are Northern Ireland's most important industries?
What political party has controlled the government of Northern Ireland throughout most of the country's history? Why was this party formed?
What is Northern Ireland's chief manufactured product?
Why is there a split between Protestants and Roman Catholics in Northern Ireland?
What languages are spoken in Northern Ireland?
What is Northern Ireland's most popular organized sport?
What was the Government of Ireland Act?
Why is agriculture important in Northern Ireland?

Northern lights. See Aurora.

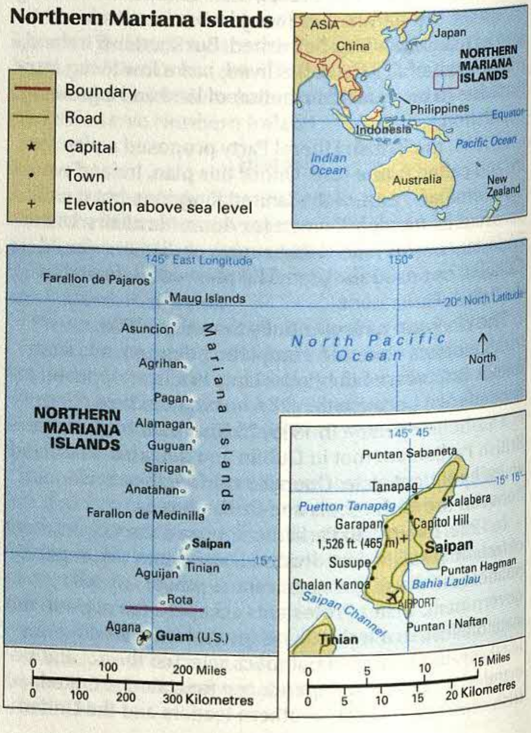
Northern Mariana Islands, Commonwealth of the, is a chain of 16 islands in the Pacific Ocean. The islands are a commonwealth of the United States. They lie about 1,600 kilometres south of Japan and about 2,400 kilometres east of the Philippines. The Northern Marianas extend about 543 kilometres from north to south and cover about 477 square kilometres of land. They are part of a larger region in the Pacific Ocean called *Micronesia.* Together with Guam, the Northern Marianas make up the Mariana Islands.

About 43,000 people live in the Northern Marianas. About 90 per cent of the population live on Saipan, the capital and largest island. Most of the rest of the people live on the islands of Tinian and Rota.

In 1947, the United States began administering the Northern Marianas as part of the Trust Territory of the Pacific Islands. The Northern Marianas became a self-governing commonwealth of the United States in 1986. The commonwealth government handles the commonwealth's internal affairs. The United States is responsible for defence and foreign affairs. Island residents are U.S. citizens, but they cannot vote in presidential elections.

Government. A governor heads the commonwealth government. The governor is assisted by a lieutenant governor. The voters elect both these officials to four-year terms. A two-house legislature makes the commonwealth's laws. The Senate has 9 members and the House

Northern Mariana Islands



of Representatives has 18 members. Members are elected to two-year terms.

People. About one-third of the people of the Northern Marianas are Chamorros. Their ancestors had begun settling on the islands by about 1500 B.C. Another main group is the Carolinians, whose ancestors began to settle on Saipan around 1815 after typhoons destroyed their homes in southern Micronesia. Foreign workers account for over half the population. Filipinos make up the largest group of these workers.

At home, the Chamorros speak Chamorro and the Carolinians speak Carolinian. But English is also widely spoken in the Northern Marianas, particularly among young people. Many older people speak conversational Japanese. The majority of the people are Roman Catholics. However, a large number of islanders also hold beliefs and observe *taboos* (forbidden actions) from local religions.

Children from 6 to 16 years of age must attend school. English is the main language of instruction.

Many houses on the islands are made of wood or cement block with sheet metal roofs. Modern apartment buildings have been built on Saipan.

Land and climate. The Northern Marianas are formed by the peaks of a huge undersea mountain range. The range rises more than 9.5 kilometres off the bottom of the Mariana Trench, the deepest known spot in the world's oceans. The northern islands are covered with volcanic rock. Seven of them—Alamagan, Anatahan, Agrihan, Farallon de Pajaros, Guguan, Sarigan, and Pagan—still have active volcanoes. Limestone terraces cover volcanic rock on the southern islands. The Maug Islands, a cluster of three islands, are sometimes counted as one island. The Northern Marianas have an average year-round temperature of about 29 °C and an average annual rainfall of about 213 centimetres.

Economy. The government is the major employer in the Northern Marianas. Tourism is the most important economic activity. The garment industry is the only significant manufacturing activity. Imports far outnumber exports. More than half of the work force are foreigners. Most garment workers are Chinese or Thai.

History. The ancestors of the present-day Chamorros had begun living on the Northern Marianas by about 1500 B.C. In A.D. 1521, Ferdinand Magellan, a Portuguese explorer in the service of Spain, discovered Rota and Guam. Spain claimed the islands in 1565. But Spain did not begin ruling them until 1668, after Spanish Jesuits established a missionary settlement on Guam.

At the end of the Spanish-American War in 1898, Spain turned Guam over to the United States. The next year, Spain sold the Northern Marianas to Germany. Germany ruled the Northern Marianas until the Japanese seized them at the beginning of World War I in 1914. After the war ended in 1918, a mandate from the League of Nations gave Japan control of the islands.

The United States gained control of the Northern Marianas in 1944, during World War II. In 1947, the United States began administering the islands as part of the United Nations Trust Territory of the Pacific Islands. The Northern Marianas became a self-governing U.S. commonwealth on Nov. 3, 1986.

See also **Pacific Islands; Saipan.**

Northern pike. See **Pike.**

Northern Province is a province in the northernmost part of South Africa. It shares country borders with Botswana, Zimbabwe, and Mozambique and provincial borders with North West, Gauteng, and Eastern Transvaal. The province came into being on April 27, 1994 as Northern Transvaal. In 1995 it changed its name to Northern Province. The main cities and towns are Pietersburg, Seshego, Namakgale, and Mahwelereng.

People. For Northern Province's total population, see the *Facts in brief* table with this article. Women outnumber men because many men have migrated to other parts of South Africa in search of work. The province has a high proportion of young people, and over 50 per cent of the population are younger than 14 years of age. More than 85 per cent of the people live in rural areas. The most commonly spoken languages are North Sotho, Shangaan, Venda, Afrikaans, and Tswana. About 97 per cent of the people of Northern Province are of African descent.

Government. Pietersburg is the provincial capital of Northern Province. The province has 20 seats in the National Assembly and a 40-seat Provincial Legislature of elected representatives. A provincial premier heads a Cabinet of ministers who carry out the functions of the regional government.

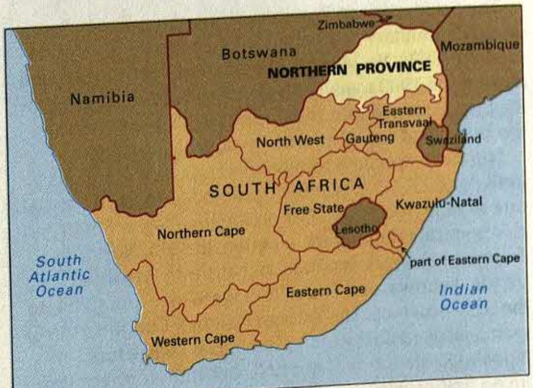
Economy. The economy of Northern Province is based largely on agriculture and mining.

About one third of the province's farmers are *subsistence farmers,* growing food to meet their own needs. The main commercial farm products are citrus fruit, coffee, cotton, grapes, maize, peanuts, sisal, sorghum, subtropical fruit, tea, tobacco, tomatoes, and wheat. Zebediela, south of Pietersburg, is the world's largest citrus estate. Forestry is an important activity in the eastern parts of the province.

Minerals mined in Northern Province include antimony, asbestos, chrome, coal, copper, diamonds, fluorspar, graphite, iron ore, manganese, nickel, phosphates, silver, tin, uranium, and vanadium.

Most manufacturing in Northern Province is linked to mining and agriculture. Metal smelting, cotton ginning, citrus packing, peanut butter making, and tobacco processing are important activities.

Land. Most of the western and central parts of North-



Northern Province is one of South Africa's nine provinces. It shares country borders with Botswana, Zimbabwe, and Mozambique.

Facts in brief about Northern Province

Population: *1994 estimate*—5,120,600.
Largest cities and towns: Seshego, Pietersburg, Namakgale, Mahwelereng.
Area: 119,606 km²
Languages: North Sotho, Shangaan, Venda, Afrikaans, Tswana. Thohoyandon, Messina, Phalaborwa-Lulekani.
Chief products: *Agriculture*—citrus fruit, cotton, maize, groundnuts, tobacco, tomatoes, and wheat. *Manufacturing*—citrus packing, cotton ginning, metal smelting, and peanut butter. *Mining*—antimony, asbestos, chromium, copper, iron ore, magnetite, manganese, nickel, uranium, and vanadium.

ern Province lie on the *middleveld* (midlands), at an average height of 1,200 metres above sea level. Scrub vegetation called *bushveld* covers much of the region, with wooded areas and grasslands occurring in some places. The eastern edge of the province lies in the *lowveld* (lowlands) at an altitude of about 500 metres.

Northern Province's main mountain ranges are the Soutpansberg in the north (1,747 metres), the Waterberg in the south (2,088 metres), and the Transvaal Drakensberg in the southeast (2,000 metres).

Rivers and lakes. The province is drained by several tributaries of the Limpopo River. Lake Fundudzi in the Soutpansberg is South Africa's only natural lake.

Climate. The climate of Northern Province is influenced by altitude. The middleveld and higher lying regions have a temperate climate with warm, moist summers and cool, dry winters. Rainfall decreases steadily from east to west. The province is prone to drought, especially in the western and northern regions. See **South Africa** (maps: Precipitation, Temperature).

History. Archaeologists have discovered evidence of early human habitation in Northern Province, dating from thousands of years ago. The ancestors of today's Venda people crossed the Limpopo River from the north in the 1300's and established stone-walled settlements in the Soutpansberg. The Pedi (North Sotho) and other farming communities settled in other parts of what is now Northern Province.

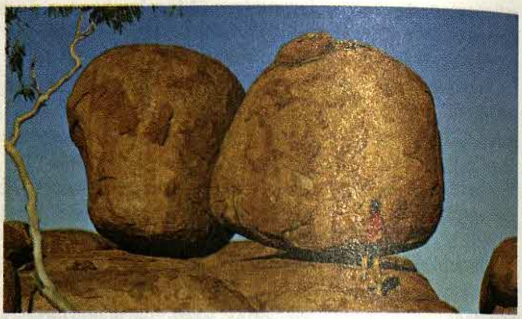
Afrikaans-speaking farmers of European descent, known as *Boers,* first entered the region in the 1830's. The Pedi, under Sekhukhune, successfully resisted Boer incursions but were defeated by the British army in 1877.

The South African Republic (ZAR) of the Boers launched military campaigns against the Venda during the late 1800's. By 1898, the Venda had been subjugated. During the 1900's, many black Africans in Northern Province were forced into tribal reserves that later became the homelands of Venda, Lebowa, and Gazankulu.

Northern Province remained a region of Transvaal until April 27, 1994, when it became Northern Transvaal, one of nine new provinces on the first day of South Africa's first truly democratic election. In 1995, Northern Transvaal changed its name to Northern Province. Venda, Lebowa, and Gazankulu were incorporated into the new province. The African National Congress (ANC) won a large majority in the Provincial Legislature. Ngoako Ramatlhodi of the ANC became Northern Province's first provincial premier.

See also **Kruger National Park; Pietersburg; South Africa.**

Northern Rhodesia. See Zambia.



Devil's Marbles are a strange collection of giant rocks balanced one on top of another just south of Tennant Creek.

The Olgas, huge rocks not far from Ayers Rock, are especially colourful because they consist of more than one type of rock.

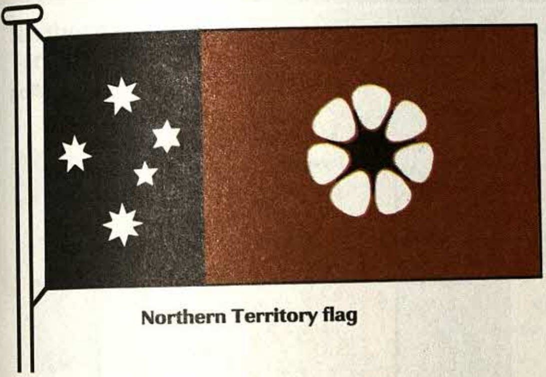
Northern Territory occupies almost a sixth of the Australian continent. It covers a huge area of the country's north and centre. It is bordered by the Arafura and Timor seas, Queensland, South Australia, and Western Australia. The territory, which is sometimes called *Outback Australia*, is known for its scenery and its mineral wealth.

About four-fifths of the Northern Territory lies within the Torrid Zone, north of the Tropic of Capricorn. The territory is roughly divided into two parts. The northern part, known as *The Top End,* receives heavy rainfall for three to five months of the year. The southern area, known as *The Centre,* has low rainfall and no permanent rivers.

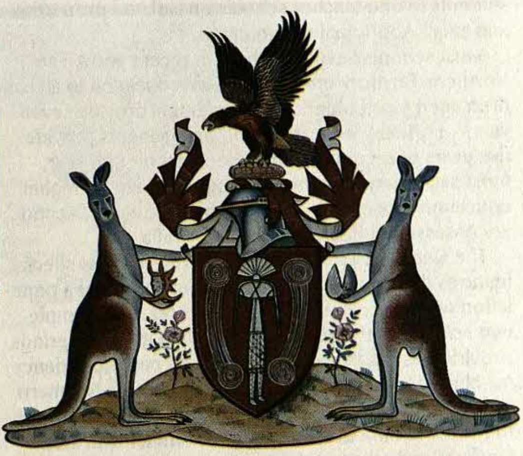
Government

The Northern Territory is a territory of the Commonwealth of Australia. It was granted self-government on July 1, 1978, by the Northern Territory (Self-Government) Act. As the territory's constitution, this act has made possible the establishment of a government of the Northern Territory. The territory's ministers and public servants hold executive and administrative responsibility for most functions performed by state governments in the six states of Australia.

The Northern Territory Self-Government Act provides for the appointment by the governor general of an administrator, charged with the duty of administering the government of the territory. The administrator occupies a role that is becoming increasingly similar to that of a state governor. The act also provides for a Legislative



Northern Territory flag



Northern Territory coat of arms

Symbols of the Northern Territory. The coat of arms shows the territory's *faunal* (animal) emblems, the red kangaroo and the wedge-tailed eagle. The shield bears two Australian Aboriginal designs. A design used on a sacred carved object called a *churinga* appears on either side of a woman's figure from Arnhem Land. The territory's flag includes the Southern Cross constellation, which occurs on the Australian national flag, and the territory's floral emblem, the Sturt's desert rose. The seven petals of the flower symbolize the six Australian states and the Northern Territory. The flag was first flown on July 1, 1978, to mark the granting of self-rule to the Northern Territory.

Floral emblem
(Sturt's desert rose)

Assembly, which consists of 25 members elected every four years.

Ministers are chosen from the party with the largest number of members elected to the assembly. The administrator officially appoints these ministers to specific *portfolios* (duties). The ministers form an Executive Council to advise the administrator in relation to matters in which the ministers have executive authority. The administrator makes regulations on the advice of the Executive Council. Proposed laws passed by the Legislative Assembly are presented to the administrator for assent.

In the federal Parliament, in Canberra, the Northern Territory is represented by two senators and one member of the House of Representatives. All three have full voting and representational rights.

In local government, larger cities such as Darwin, Alice Springs, Katherine, Tennant Creek, Jabiru, Palmerston, and Litchfield Shire have fully elected local government bodies. In other centres, local government functions are carried out by the government of the Northern Territory.

People

For Northern Territory's total population, see the *Facts in brief* table with this article. The people in the Northern Territory, and particularly in Darwin, make up one of the most cosmopolitan populations in Australia. Darwin's population includes a large number of Greeks, Italians, Germans, French, and other people from Europe. Darwin's Asian population includes Chinese, Malaysians, Filipinos, and Vietnamese.

About 29,000 Aborigines live in the territory, and the Aboriginal population is increasing. About two-thirds of the Aborigines live in communities or missions in remote areas. Some Aborigines are in major centres, most of them living under primitive conditions.

Facts in brief about the Northern Territory

Administrative centre: Darwin.
Chief towns: Darwin, Jabiru, Palmerston, Alice Springs, Katherine, Nhulunbuy, Tennant Creek.
Area: 1,346,200 square kilometres.
Population: 175,253.
Animal emblem: Red kangaroo.
Bird emblem: Wedge-tailed eagle.
Floral emblem: Sturt's desert rose.
Chief products: *Agriculture*—beef cattle, buffalo, maize, sorghum, rockmelons. *Fishing*—prawns. *Mining*—alumina, bauxite, copper, iron, gold, manganese, tin, uranium. *Manufacturing and processing*—beef, buffalo, prawns.

Nearly half the people in the territory live in Darwin, the administrative centre and capital. About a third of the people in Darwin are directly employed by the Northern Territory government or by the few federal government departments represented in the territory.

Education

The Northern Territory has more than 150 schools scattered unevenly over vast distances. The schools have a total enrolment of more than 34,000 students. Nearly a third of the students are Aborigines, many of whom live in tribal areas. Schools in the territory range greatly in size, from urban high schools of up to 1,000 students to one-teacher schools on isolated properties and small Aboriginal communities.

Most schools have been built in recent years. The Northern Territory offers preschool education to all children aged 4 and older. Primary schools provide seven years of primary education, and high schools provide five years of secondary education. In their fifth year, most secondary students wishing to qualify for higher education take examinations set by the Senior Secondary Assessment Board of South Australia.

The Northern Territory education system has special features designed to meet the unusual needs of a population widely scattered over a huge area. For example, two *schools of the air,* at Katherine and at Alice Springs, provide lessons by two-way radio and correspondence for children living in outback locations in the Northern Territory. These students are brought to the schools of the air from time to time for direct contact with their teachers and other students.

A bilingual education programme allows Aboriginal children to be instructed primarily in their own languages during the early years of schooling. As the students progress through school, English gradually becomes the main language of instruction. The programme started on an experimental basis in four schools in 1973. Today, it encompasses 14 different Aboriginal languages and 16 schools, and caters for about half of the Northern Territory's tradition-oriented Aboriginal students.

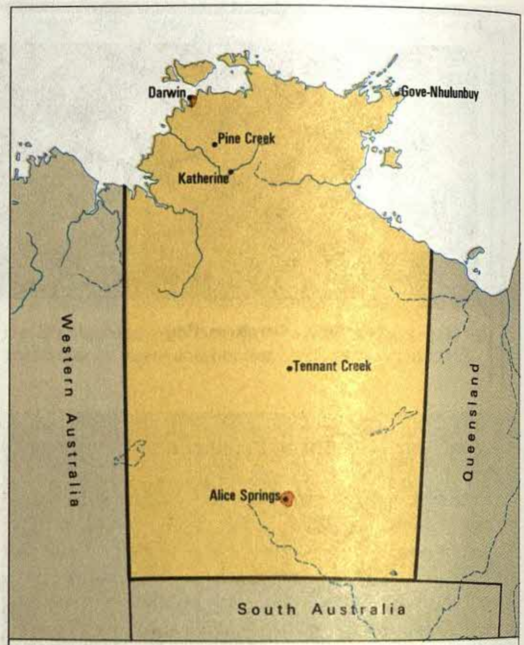
The Northern Territory has several institutions that provide technical training, further education, and advanced education courses. In 1989, the Darwin Institute of Technology merged with the University College of the Northern Territory to form the Northern Territory University. The university offers undergraduate degrees in arts, sciences, business, and economics, as well as diploma, certificate, and professional development short courses. It also has an Institute of Technical and Further Education. The university's two campuses are at Casuarina and Myilly Point. In Alice Springs, the Community College of Central Australia offers a variety of recreational, technical, and further education courses for the central Australian community. Both institutions provide tutorial support for students pursuing external courses from interstate tertiary institutions.

The Katherine Rural College conducts a two-year, full-time certificate course in rural studies, plus a wide variety of short-term courses. Batchelor College provides training for Aboriginal teachers and adult educators. It was the first college in Australia to be established specifically for this purpose. The college also conducts a course in community management for Aborigines. Adult educators provide field education services to residents of isolated communities.

Land

Location and size. The Northern Territory occupies a vast area of central and northern Australia. It is bordered by Queensland, South Australia, and Western Australia. The territory measures 1,346,200 square kilometres in area. It measures 966 kilometres from east to west and 1,600 kilometres from north to south.

Major islands off the coast are Groote Eylandt, in the Gulf of Carpentaria, and Bathurst and Melville islands, just north of Darwin. Groote Eylandt is about 64 kilometres long and 48 kilometres wide. The island has extensive deposits of manganese. The ore of this metal is mined for export. Bathurst Island is about 72 kilometres long and 56 kilometres wide. Most of its inhabitants are Aborigines of the Tiwi tribe. There are also dozens of other smaller islands, some of which are inhabited by Aborigines.



Northern Territory population

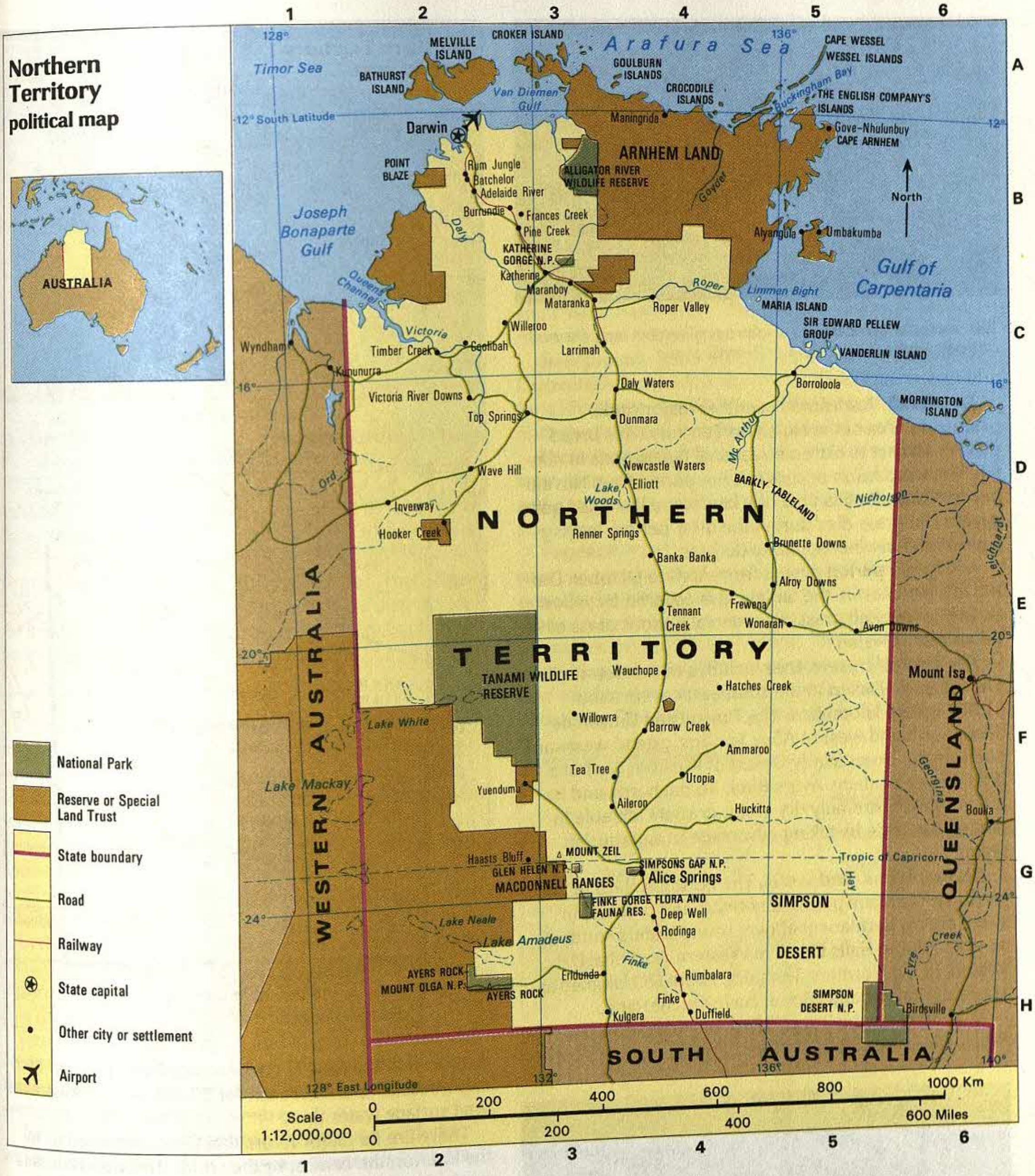
Land regions. The Northern Territory includes six of the major land regions of Australia. They are (1) the *Darwin Region,* to the northwest; (2) the *Victoria River Basin,* south and west of the Darwin Region; (3) *Arnhem Land,* in the north; (4) the *Gulf Country,* to the northeast; (5) the *Barkly Tableland,* just south and west of the Gulf Country; and (6) the *Central Desert Area,* which covers the entire southern part of the territory.

The Darwin Region is important largely because it includes Darwin, the territory's capital. Nearly half the people in the territory live in Darwin. Rivers, lakes, and lush semiforest lands lie within easy reach of Darwin's inhabitants.

The Victoria River Basin is a subtropical area. The Victoria River flows north and west into the Timor Sea. Its basin includes some of the finest cattle properties in the Northern Territory. Many Aborigines live in the area, but there are no major towns.

Arnhem Land is bordered on the north by the Arafura Sea and on the east by the Gulf of Carpentaria. This re-

Northern Territory political map



Northern Territory map index

Cities and towns

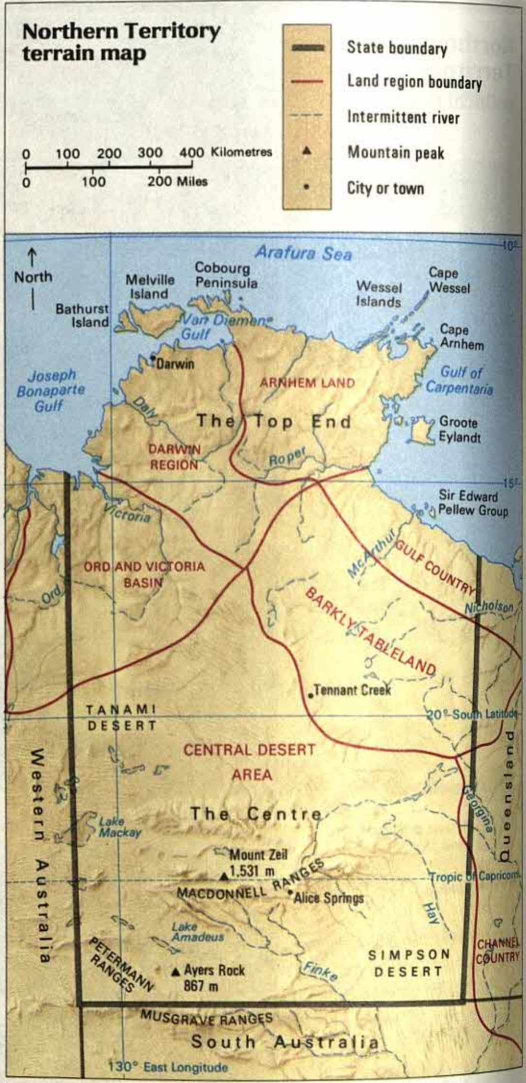
Adelaide River		B	2
Alice Springs	25,586	G	4
Alyangula	1,244	B	5
Ammaroo		F	4
Amoonguna*		G	4
Angurugu*	613	B	5
Areyonga*		G	3
Avon Downs		E	5
Bamyili-Beswick*	762	C	3
Barrow Creek		F	4
Batchelor	358	B	2
Bathurst Island*		A	2
Borroloola	659	C	5
Burrundie		B	3
Coolibah		C	2
Croker Island*		A	3
Daly River*	237	B	2
Daly Waters		C	3
Darwin	78,139	A	2
Deep Well		G	4
Docker River*	257	H	2
Duffield		H	4
Dunmara		D	3
Finke		H	4
Frances Creek		B	3
Galawinku*	1,027	A	5
Goulburn Island*		A	3
Gove-Nhulunbuy	3,515	A	5
Haasts Bluff		G	3
Hermannsburg*	506	G	3
Hooker Creek	605	D	2
Inverway		D	2
Katherine	9,372	B	3
Maningrida	645	A	4
Maranboy		C	3
Melville Island*		A	2
Milingimbi*	618	A	4
Newcastle Waters		D	3
Ngukurr*	660	C	4
Nhulunbuy, see Gove-Nhulunbuy			
Numbulwar*	408	B	5
Oenpelli*	633	A	4
Papunya*	340	G	3
Pine Creek	393	B	3
Port Keats*	909	B	2
Roper Valley		C	4
Rum Jungle		B	2
Rumbalara		H	4
Santa Teresa*	427	G	4
Tea Tree		F	3
Tennant Creek	3,478	E	4
Timber Creek		C	2
Top Springs		D	3
Umbakumba	269	B	5
Utopia		F	4
Wave Hill		D	2
Willowra		F	3
Wonarah		E	5
Yirrkala*	565	B	5
Yuendumu	754	F	3

*Does not appear on the map; key shows general location.
Sources: 1991 census preliminary figures; 1986 census for smaller places.

gion has a tropical climate. Like the Darwin Region, it remains green most of the year. It contains some of the richest mineral deposits in the world. Arnhem Land is an Aboriginal reserve. See **Arnhem Land.**

The Gulf Country, a narrow region south of Arnhem Land, lies between the Barkly Tableland and the Gulf of Carpentaria. It has dozens of isolated pastoral properties. It contains the McArthur River lead-zinc deposits.

The Victoria River Basin, a subtropical region, includes such cattle stations as Victoria River Downs, *above.*



The Barkly Tableland is another major cattle-producing area of the Northern Territory. This broad plain is subject to extreme seasonal fluctuations in rainfall. The *wet season* occurs in a hot period from November to March. At this time, the landscape becomes quite green. The grass dies during the drier period, leaving bare earth between the tussocks.

A long dry period occurs from April to October. During this *dry season,* the tableland is covered by yellow, strawlike Mitchell grass, a perennial tussock grass of little nutritional value.

The Central Desert Area includes two desert regions. The Simpson Desert in the southeast covers about 51,800 square kilometres. The Tanami and Gibson deserts, north and west of Alice Springs, extend westward and join the Great Sandy Desert of Western Australia. This region contains Ayers Rock. To the north, and between these extremely dry areas, graziers are able to rear some cattle by taking advantage of subartesian water.

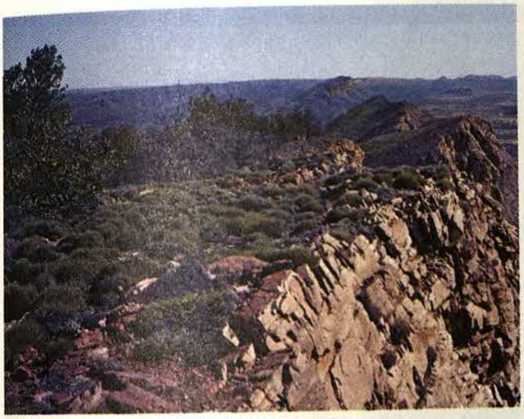
Rivers, lakes, and wells. The northern third of the territory has many permanent rivers and creeks. But there are no permanent aboveground waters south of an area joining Halls Creek in Western Australia; Daly Waters in the Northern Territory, about 650 kilometres south of Darwin; and Mount Isa in Queensland.

In addition to the Roper River, the Rose, Cox, Limmen, Bight, McArthur, Robinson, and Calvert rivers all flow to the east into the Gulf of Carpentaria. The Northern Territory's coastal rivers account for 30 per cent of Australia's total surface water flow.

Central Australia includes the Barkly Tableland, an area of wide, open plains with large cattle stations.

There are no major rivers that flow continuously in the interior, the centre, or the south. The watercourses marked as major rivers on many maps are actually the flood plains of rivers and creeks that flow only after heavy rains. At all other times, the stream beds become a string of water holes or dry up completely. The Todd River is one of the best known of the central rivers because Alice Springs is built on its banks. Usually the river bed is dry. The Finke, which vanishes underground into the desert area near the border with South Australia, is a well-known river in the south. The Darwin River Dam forms the territory's biggest reservoir. The reservoir has a total surface area of about 44 square kilometres.

The Great Artesian Basin extends from Queensland into only 10 per cent of the Northern Territory, along its eastern boundary. Underground water can be pumped to the surface from other artesian basins. Water from



The Macdonnell Ranges near Alice Springs have rich colours that inspired the Aboriginal artist Albert Namatjira.

these wells enables farmers to raise cattle in the interior. Bores vary in depth from 15 metres in the Victoria River district to several hundred metres in the Alice Springs district, with an average depth of 50 metres. They supply essentially all water used for cattle in these districts and the Barkly Tableland. The Northern Territory contains 40 per cent of Australia's underground water.

Climate

The northwest monsoon greatly influences the climate in most areas of the Northern Territory. The average rainfall varies from 1,800 millimetres on the north coast to about 600 millimetres at Daly Waters, 300 millimetres at Tennant Creek, 225 millimetres at Alice Springs, and only 127 millimetres around Finke on the South Australian border. The monsoon effect is most pronounced in the northern third of the territory, which is known as the *Top End.*

Cyclones form in the Timor and Arafura seas from the months of November to April. Occasionally, one of these cyclones brings storms to the areas around Darwin, Arnhem Land, and the Gulf of Carpentaria.

December to April are hot and humid in Darwin, and monsoon winds bring almost continuous rain. During these months, Darwin receives almost 90 per cent of its annual rainfall of 1,600 millimetres.

Temperatures in the monsoonal area vary with the wet and dry seasons. The wet season extends from December to March or early April. During this season, the relative humidity often reaches more than 90 per cent. In the hottest months, the temperatures in the north range from about 26 to 36 °C. Even in the dry season, the temperature in this area rarely falls below 15 °C. At Alice Springs, temperatures fall as low as −7 °C in the winter months. In midsummer, November to March, the temperature can rise as high as 47 °C. Frosts often occur south of Tennant Creek.

Economy

Natural resources. The Northern Territory is rich in some natural resources. The territory has deposits of minerals and natural gas.

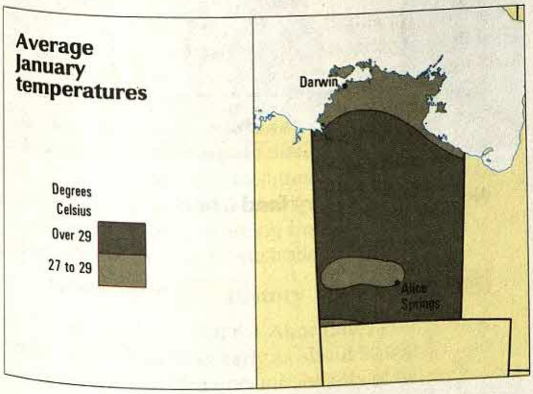
Soils provide good grazing areas around the Gulf of Carpentaria in the McArthur River Basin and in the Victoria River area. The Barkly Tablelands and the Alice Springs district also have good grazing land.

Water is plentiful in the northern third of the territory from permanent rivers and heavy rainfall. The centre and desert areas can draw water from underground sources.

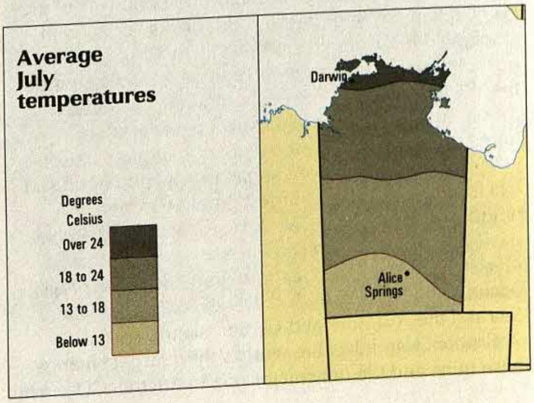
Vegetation patterns follow the rainfall areas. Pandanus, coconut palms, mangrove swamps and forests, paperbarks, pines, and eucalypts grow in the coastal regions. Some tropical grasses in this area grow as high as 3.5 metres during the wet season. The lushness of the north gives way to green savannah woodland. Still further south, timber thins out into semidesert or spinifex country. In the east, the elevated Barkly Tableland is a

Average monthly weather

	Darwin				Alice Springs		
	Temperatures C°		Days of rain or snow		Temperatures C°		Days of rain or snow
	High	Low			High	Low	
Jan.	32	25	19	Jan.	37	22	4
Feb.	32	25	18	Feb.	36	21	4
Mar.	32	25	17	Mar.	33	18	3
Apr.	33	24	8	Apr.	29	14	2
May	32	22	1	May	23	9	3
June	31	21	0	June	20	6	3
July	31	19	0	July	19	5	3
Aug.	32	21	0	Aug.	22	7	2
Sept.	33	23	2	Sept.	26	10	2
Oct.	34	25	5	Oct.	31	15	4
Nov.	34	26	11	Nov.	34	18	5
Dec.	33	26	16	Dec.	35	20	5



Average January temperatures



Average July temperatures

Dust storms occur in dry inland areas of the territory. They reduce visibility and make travelling difficult.

huge tract of flat grassland. In the west, the Victoria River district supports grasses such as kangaroo, Mitchell, and Flinders. The hill country is covered with nutwood trees, cabbage gums, bauhinia trees, and bloodwoods, coolibahs, and other eucalypts.

Wildlife is an important natural resource in the Top End because it attracts a growing number of tourists. Wildlife has continued to flourish in this area largely because of the sparse population and lack of interference from human activities.

Scientists have recorded more than 2,800 *species* (kinds) of plants. The territory has more than 350 species of birds and 100 species of mammals, including 40 marsupials. More than 50 species of fish have been recorded. There are many insects and more than 100 kinds of butterflies. Several of the world's 26 species of crocodiles are found in the northern area.

Mining is the territory's greatest source of wealth. Some of the world's largest deposits of uranium, bauxite, and manganese are located in the Northern Territory. There are also deposits of oil and natural gas. Other important mineral deposits include gold and copper.

Almost 50 per cent of the Northern Territory has been granted as Aboriginal land or is under Aboriginal land claim. These areas contain much of the land that is being mined. Aborigines who own or claim such land receive payments calculated in a manner similar to royalties, in addition to receiving compensation payments.

The Alligator rivers region has huge deposits of uranium at Ranger, Koongarra, and Jabiluka, along with stockpiled ore from the completely mined Nabarlek deposit. In total, these reserves represent 20 per cent of the Western world's low-cost uranium resources.

A mine on the Gove Peninsula in northeastern Arnhem Land supplies about a sixth of Australia's bauxite.

The Northern Territory began production of oil and gas in 1983. Australia's longest pipeline extends the length of the Northern Territory, carrying Palm Valley gas 1,500 kilometres to Darwin and other centres for electricity generation. Offshore, huge deposits of gas occur in the Bonaparte Gulf. Oilfields lie in the Timor Sea and the Ashmore and Cartier islands area.

Groote Eylandt has the world's third-largest manganese mine and the only major one in Australia. Ore from the mine is sent to other parts of Australia and to many other countries, including Russia and China.

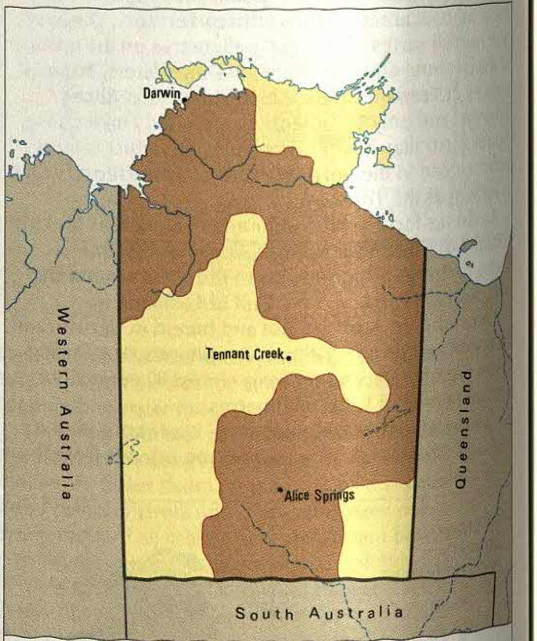
About a fifth of Australia's gold is produced in the Northern Territory. The main mines are at Pine Creek, Tennant Creek, and The Granites.

Farming. Cattle stations are the most important types of farms in the territory. Major roads have been built in the cattle country. Farmers have spent large sums in introducing new breeds, notably the Brahman, and in pasture feeding. Buffaloes provide a small but growing income for producers. Producers export live cattle and buffaloes as well as meat.

There are a few pockets of small farms in the Alice Springs, Adelaide River, and outer Darwin areas. Commercial crops grown in the Top End include maize, mung beans, peanuts, rice, sorghum, and soybeans. A small but successful horticultural industry produces rockmelons, watermelons, tomatoes, and bananas for sale on southern markets.

Fishing. The annual value of production of the Northern Territory's fishing industry is about 25 million Australian dollars. The industry is based on production of barramundi and prawns.

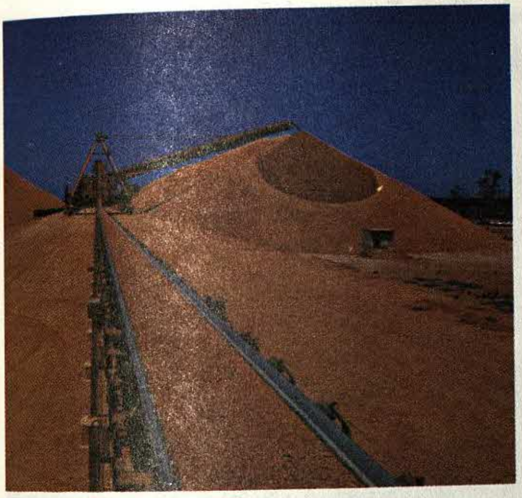
In the late 1980's, attempts were made to establish a shark-fishing industry in the Northern Territory. The territory's department of fisheries keeps a watch on fishing practices to preserve the basic resources and to ensure the long-term profitability of the industry. The department's aim is also to develop new fisheries.



Northern Territory land use

▨ Beef cattle zone

▨ Nonagricultural land



The mining industry is the territory's greatest source of wealth. Gove has huge bauxite deposits.

Manufacturing employs only a small percentage of the workforce. Apart from roadbuilding and other government work, the main manufacturing industries are the building industry, prawn-processing firms, and brickmaking and steelworks.

Many Aborigines on Bathurst Island work in a clothing factory. Aboriginal artists produce pottery, bark paintings, and other artefacts.

Transportation and communication are a problem in the territory because of floods, because of the great distances between population centres, and because of the distance to other major centres in Australia. The Northern Territory and federal governments have supported a roadbuilding programme involving millions of dollars. A railway links Alice Springs with Australia's major rail network. In the early 1980's, the federal government pledged to continue the line right through to Darwin. But in 1984, the Labor government decided not to proceed with the proposal.

Darwin is the principal Northern Territory port for general and containerized cargo. Bulk loading operations are located at Gove and Groote Eylandt.

Darwin's international airport is a first port of call for aircraft arriving from Asia. It is also an Australian departure point for flights to such places as Singapore, Indonesia, New Zealand, and Brunei.

Within Australia, there are daily flights from Darwin to Alice Springs and Yulara with connections to all Australian state capital cities. These services are offered by Australia's two main domestic carriers, Australian Airlines and Ansett Airlines of Australia. Television, radio, and communications are via fibre-optic and terrestrial radio links. TV and radio facilities at many centres are provided by the AUSSAT satellite system. The system distributes ABC programming both from Darwin and other national centres in Australia.

History

Scientists believe that the Aborigines arrived in Australia from the north as early as about 50,000 B.C. Aborigines remained the only inhabitants of the territory until the 1400's, when the New Guineans, Macassans, and Torres Strait Islanders came in across the sea.

The first recorded European visits to the Northern Territory occurred almost 200 years later. The first European visitors were Dutch navigators. Between 1606 and 1756, they moved along the coast, charting and naming geographic locations.

In 1803, Matthew Flinders charted many sections of the northern coast during his voyage around Australia. Between 1824 and 1868, four attempts by Europeans to establish a permanent settlement on Australia's northern coast failed.

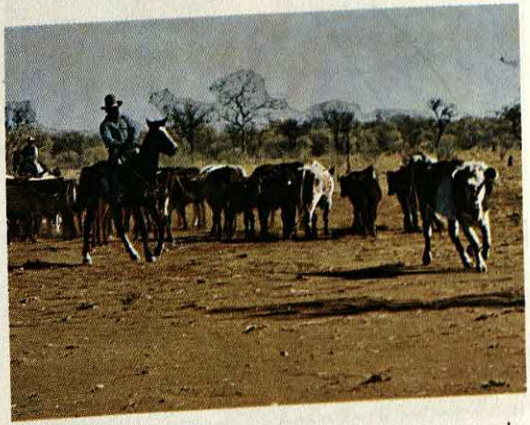
In 1869, George Woodroffe Goyder, surveyor general of South Australia, went north with 100 men. He succeeded in his attempt to make a permanent settlement in northern Australia. At first the settlement was called *Palmerston*, but later it was renamed *Port Darwin*.

The Aborigines suffered greatly after the arrival of the Europeans. Thousands were killed in massacres and land takeovers. Others starved to death after the settlers deprived them of their hunting grounds and disrupted their natural *nomadic* (wandering) existence. Tens of thousands died of diseases, such as tuberculosis, brought in by the Europeans, and of leprosy, brought in by the Chinese. Even today, the Aboriginal population is only a fraction of the number that lived in the area when the Europeans arrived in the 1800's. After they were deprived of their traditional hunting grounds, many mixed groups settled on Christian missions, where they were given shelter and food.

During the early, difficult years, distances presented greater problems than they do today. There were no roads in Australia's centre or far north. Exploration to the interior aroused interest in the area.

Ludwig Leichhardt travelled from Brisbane to Port Essington, near Darwin, in 1845. He was the first European explorer to travel through the territory. He discovered the Barkly Tableland, which later became a cattle-raising area. This discovery caused Queensland to move its border further west. See **Leichhardt, Ludwig.**

John McDouall Stuart crossed the continent from south to north in 1862. As a result of his expedition, South Australia took over the territory from the British government in 1863. Between 1870 and 1872, Sir Charles



Cattle in the Northern Territory are mustered for interstate sale and are also slaughtered locally for export.

Todd supervised the building of the Overland Telegraph along Stuart's route between Adelaide and Darwin. The Australian federal government took over control of the territory in 1911.

Small amounts of gold were found in 1865, but they did not create much interest. Mining became the Northern Territory's greatest source of wealth after the first payable gold was discovered in 1870, and a gold rush to the Pine Creek area followed in 1872.

In 1942, during World War II, the Japanese flew 65 bombing raids against targets in the Northern Territory. Bombs destroyed half of Darwin's buildings, killed hundreds of citizens, and gave the north a special place in Australian history. It was the first area in Australia ever to suffer heavy damage from enemy attack. But the war also saw construction of the Stuart and Barkly highways and improved power and water supplies in the north.

Government aid and private money finally began to flow into the Northern Territory in large quantities in the 1960's. Australia's only manganese mine opened at Groote Eylandt in 1965. It was followed by one of Australia's main bauxite-alumina projects at Gove.

In 1949, John Michael White, a prospector, first discovered uranium at Rum Jungle, about 100 kilometres south of Darwin. In 1970, large deposits of uranium were discovered at Ranger, Nabarlek, and Koongarra. In 1971, huge reserves of uranium were discovered at Jabiluka. Work began on the Nabarlek deposits in 1978 and on the Ranger deposits in 1980. Important oil and gas discoveries followed in the 1980's.

Cyclone Tracy destroyed 90 per cent of Darwin on Dec. 25, 1974. By 1977, the city was rebuilt and it had regained its precyclone population. Transfer of power from the Australian federal government to the Northern Territory's Legislative Assembly culminated in self-government on July 1, 1978.

Related articles in *World Book* include:

Alice Springs
Australian Aborigines
Ayers Rock
Bathurst Island
Darwin
Gulf of Carpentaria
Mount Zeil
Simpson Desert

Outline

I. Government
II. People
III. Education
IV. Land
  A. Location and size
  B. Land regions
  C. Rivers, lakes, and wells
V. Climate
VI. Economy
  A. Natural resources
  B. Mining
  C. Farming
  D. Fishing
  E. Manufacturing
  F. Transport and communication
VII. History

Questions

When was the Northern Territory granted self-government?
How many senators represent the Northern Territory?
Why is the population of Darwin said to be the most cosmopolitan in Australia?
How many Aborigines live in the territory?
Ayers Rock is a famous landmark. What is its Aboriginal name?
Why does the territory need schools of the air?
Which important minerals are mined in the Northern Territory?
How is the Central Desert Area supplied with water?
When was the first permanent European settlement made in northern Australia?

Northern Transvaal. See Northern Province.

Northmen. See Vikings.

Northumberland is the most northerly county of England. The county's northwestern border forms most of the boundary between England and Scotland. The county has many historical associations, especially with Roman times.

Northumberland is mainly agricultural. At one time, the county's main economic importance was in the industrial area of Tyneside. But, in 1974, this part of Northumberland was taken into a new county, Tyne and Wear. The change reduced Northumberland's population by a half. Northumberland is one of the largest English counties in area, but is more sparsely populated than any other county in England.

People and government

Many *Northumbrians* (inhabitants of Northumberland) work in farming. Some in the southeastern parts of the county work in the declining coal-mining industry.

Local customs. The county has many old legends and customs. An example is tar burning on New Year's Eve at Allendale. This custom probably dates from pre-Christian times, when people worshipped fire. Led by a band, masked men march through the town carrying barrels of blazing tar. The barrels are thrown on a bonfire in the market square.

Recreation. The River Tweed is a famous salmon-fishing river. All the county's rivers, and the long coast, give good facilities for anglers. Northumberland National Park covers nearly 1,040 square kilometres. Its moors and hills attract many walkers and pony trekkers. Next to the national park is the Border Forest Park. The county's plentiful wildlife is an added attraction.

Most national sports are popular in Northumberland. Many people play rugby football. Association football is popular throughout the county. The mining towns are famous for their colliery brass bands.

Local government. Northumberland has six local government districts. They are: *Alnwick; Berwick-upon-Tweed; Blyth Valley; Castle Morpeth,* which includes Morpeth and Ponteland; *Tynedale,* which includes Hexham and Bellingham; and *Wansbeck,* which includes Ashington and Bedlington.

Economy

Agriculture and fishing. Most of the county's arable land is in the central plain and coastal areas. Barley is the main crop, but farmers also grow oats, potatoes, sugar beet, wheat, and various crops for animal food. The Morpeth and Ponteland areas have market gardening. Farmers in the lowlands keep beef and dairy cattle. In the uplands, sheep farming is the main activity. Ber-

Facts in brief about Northumberland

Largest towns: Blyth, Morpeth, Berwick-upon-Tweed.
Area: 5,035 km².
Population: *1991 census*—300,600.
Chief products: *Agriculture*—barley, beef and dairy cattle, oats, potatoes, sheep, sugar beet, wheat. *Fishing*—herring, salmon. *Manufacturing*—bricks, clothing and textiles, electronics goods, engineering goods, paper tissues, razor blades. *Mining*—coal.

Berwick-upon-Tweed, one of the few towns in Northumberland, lies in the extreme north of the county, alongside the River Tweed.

wick-upon-Tweed is a centre for North Sea fishing. Craster is famous for kippers. The lower reaches of the River Tweed have a salmon-fishing industry.

Manufacturing. Most of the county's manufacturing is in its southeastern corner. Cramlington is a developing industrial town with products that include cigarette lighters and powered tools. Blyth has a trading estate, and produces clothing, components for electronics goods, and textiles for bedding and upholstery. Ashington has a brickworks. The town also has the headquarters of an aluminium smelting factory, located at nearby Lynemouth. Other local industries produce clothing and engineering goods. Marine and general engineering are important at Amble. Haltwhistle has a paint factory, and Otterburn produces blankets, rugs, and tweeds. Prudhoe has a large works making paper tissue. Bedlington has a factory manufacturing electronic components. Other industrial plants situated on the Tyne and Blyth rivers manufacture products ranging from heavy electrical machinery to pottery and soap.

Mining. The county's coalfield is part of the extensive Northumberland and Durham coalfield, the second largest in England. The main mining area is near Ashington and Bedlington. The Northumbrian mines have been affected by a general decline in British coal mining.

Tourism is a growing industry. Increasing numbers of visitors are attracted by the county's beauty, especially in the Northumberland National Park, and its small seaside resorts.

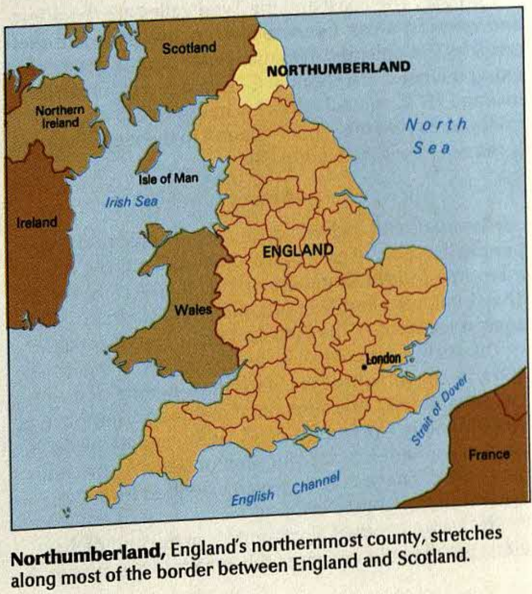
Transport and communications. A main railway line from London to Edinburgh passes through Morpeth, Alnmouth, and Berwick-upon-Tweed. A branch line, running from Newcastle upon Tyne to Carlisle, serves Prudhoe, Hexham, and Haltwhistle. The Great North Road, the A1, runs along the east coast. The main port is Blyth. Woolsington airport, near Ponteland, handles passenger and freight flights to other parts of Britain.

A BBC local radio station at Newcastle upon Tyne serves as a local station for Northumberland. Several towns in Northumberland publish their own weekly newspapers.

Land

Location and size. Northumberland is in northeastern England. It is bounded by the Borders Region of Scotland to the north, the North Sea to the east, the counties of Durham and Tyne and Wear to the south, and the county of Cumbria to the west. Northumberland extends about 110 kilometres from north to south and about 80 kilometres from east to west. See **United Kingdom** (political map); **England** (political map).

Land features. The county has three main natural regions: the coastlands, the western uplands, and part of



Northumberland, England's northernmost county, stretches along most of the border between England and Scotland.

Places to visit

Following are brief descriptions of some of Northumberland's interesting places to visit:

Bamburgh Castle has a fine cliff-top setting. It dates from the 1100's. In the village is a museum devoted to the heroine Grace Darling.

Cragside Grounds, near Alnwick, are fine gardens with rhododendrons, trees, and artificial lakes.

Farne Islands are a bird sanctuary and a breeding place for seals.

Housesteads, near Haltwhistle, is the remains of a Roman fort on Hadrian's Wall.

Lindisfarne (Holy Island) was the birthplace of Christianity in northern England. It has ruins of a priory built in the 1000's, and a castle dating from the early 1500's.

Wallington Hall, near Morpeth, has fine paintings and furniture. It was built in 1688.

the northern Pennines. The *coastland* area consists of low-lying land less than about 90 metres above sea level. It extends from Blyth in the south to about 5 kilometres beyond Berwick-upon-Tweed in the north. This coastal strip is about 16 kilometres wide. Many islands lie off the shore of Northumberland, including the Farne Islands and Holy Island.

The *western uplands* rise from the coastlands to the western borders of Northumberland. They form the approach to the Cheviot Hills, which lie along the border of England and Scotland.

The area of the *northern Pennines* lies in the southwest of Northumberland. The Tyne Gap, the valley of the South Tyne River, separates this region from the western uplands. The Pennine Chain is a series of uplands, more than 600 metres high in parts. It extends from Northumberland southwards to Derbyshire and Staffordshire. See **Pennine Hills.**

Rivers. The most important river, the Tyne, begins where the North and South Tyne rivers meet. In the North Tyne valley, the vast Kielder Water reservoir became operational in the early 1980's. It is Europe's biggest reservoir. The River Tweed forms part of the boundary between England and Scotland.

Climate. The coast and the Tyne Valley are the driest and warmest areas, because they are low lying and sheltered by the uplands. Average winter temperatures along the coast are about 3° C. Summer temperatures average 15° C. Annual rainfall is between 635 and 760 millimetres . On the higher ground in the west, temperatures are lower than in the east.

History

Historians and archaeologists believe that prehistoric people lived in the area of Northumberland. The Romans invaded Northumberland between A.D. 70 and 80. They built many fortifications, including Hadrian's Wall, against the raids of the Picts and Scots from Scotland.

The early Anglo-Saxon invasions occurred in the 400's. By the middle of the 500's, the kingdom of Bernicia, ruled by Ida, the chieftain of the Beornish tribe, was established in Northumberland. At the end of the 500's, Bernicia united with the kingdom of Deira to form the kingdom of Northumbria, which extended from the River Humber to the Forth.

The Danes invaded Northumbria at the end of the 700's. But they did not cross the Tyne into the area of Northumberland until after the middle of the 800's. They ravaged the country from the Tyne to the Tweed, burning every church and monastery. After the Norman Conquest of 1066, the Scots frequently invaded the area.

Several famous people lived in Northumberland. George Stephenson, who developed the steam locomotive, was born at Wylam, near Hexham. Grace Darling, the lifeboat heroine, was born at Bamburgh. Algernon Swinburne, the poet, came from an old Northumbrian family.

Related articles in ***World Book*** include:

Berwick-upon-Tweed
Cheviot Hills
Cumbria
Darling, Grace
Durham
Hadrian's Wall
Holy Island
Newcastle upon Tyne
Stephenson (family)
Swinburne, Algernon Charles
Tweed
Tyne
Tyne and Wear
United Kingdom, History of

Northumberland, Duke of. See **Kings and queens** (The Tudors).

Northumbria was the most northerly of the early English kingdoms, formed by the union of the kingdoms of Bernicia and Deira. Northumbria included all England north of the River Humber, southwestern Scotland, and eastern Scotland as far north as the Firth of Forth.

During the A.D. 600's, Northumbria was the strongest English kingdom and was the leading western European centre of learning. Its kings included Edwin, Oswald, and Oswiu. It was converted to Christianity by missionaries from Rome and by Celtic missionaries.

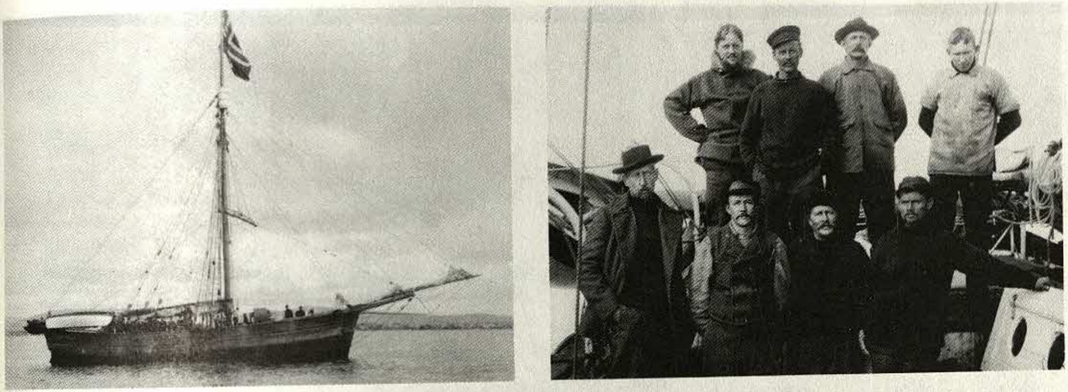
Northumbria. See **English literature** (Old English poetry); **Heptarchy.**

Northwest Ordinance, passed by the United States Congress on July 13, 1787, was one of the most important laws ever adopted. The ordinance provided for the government of the region north of the Ohio River and west of Pennsylvania in the United States, then called the Northwest Territory. It became a model for all territories that later entered the Union as states. The ordinance was largely the work of General Nathan Dane, Rufus King, and Manasseh Cutler (see **King** [Rufus]).

Under the terms of the ordinance, the territories could achieve equality with the older states by passing through three steps leading to full self-government: (1) Congress, which governed the territory, appointed a governor, a secretary, and three judges. (2) When the territory, or any division of it, attained an adult male population of 5,000, it could choose a legislature and send to Congress a delegate who could speak but not vote. (3) When the total population reached 60,000, the territory could apply for admission into the Union on terms of full equality with the older states. The ordinance removed the danger of colonial rebellion, because it assured the territories of participation in the national government.

The Northwest Ordinance contained more than a plan of government. It laid the groundwork for social and political democracy in the West. It forbade slavery. All persons were guaranteed trial by jury and freedom of religious worship. The ordinance guaranteed fair treatment for the Indians, and declared that "means of education shall forever be encouraged."

The terms of the ordinance were so attractive that pioneers poured into the new territory. In 1788, one of the first groups of settlers founded the town of Marietta,



Roald Amundsen's ship, the *Gjöa, left,* sailed through the Northwest Passage from 1903 to 1906, becoming the first ship to complete the journey. A weary Amundsen, standing far left in the picture on the right, posed with the ship's crew after arriving in Nome, Alaska.

Ohio. Thousands of families followed the first settlers in the westward movement. The territory eventually became five states—Ohio, Indiana, Illinois, Michigan, and Wisconsin. It included what is now the part of Minnesota east of the Mississippi River.

See also **Northwest Territory** (Early history).

Northwest Passage. The explorers who followed Columbus soon found that North America was not a part of Asia, as they had believed at first. At this time, British, French, and Dutch adventurers were more interested in finding an easy route to Asia than they were in exploring and settling North America. So they began to look for a "Northwest Passage," or waterway, that would take them around or through the North American continent.

The search for the Northwest Passage is a tale of adventure and heroism. In 1524, Giovanni Verrazano, sailing under the French flag, tried to find the passage. He probably explored as far north as Maine.

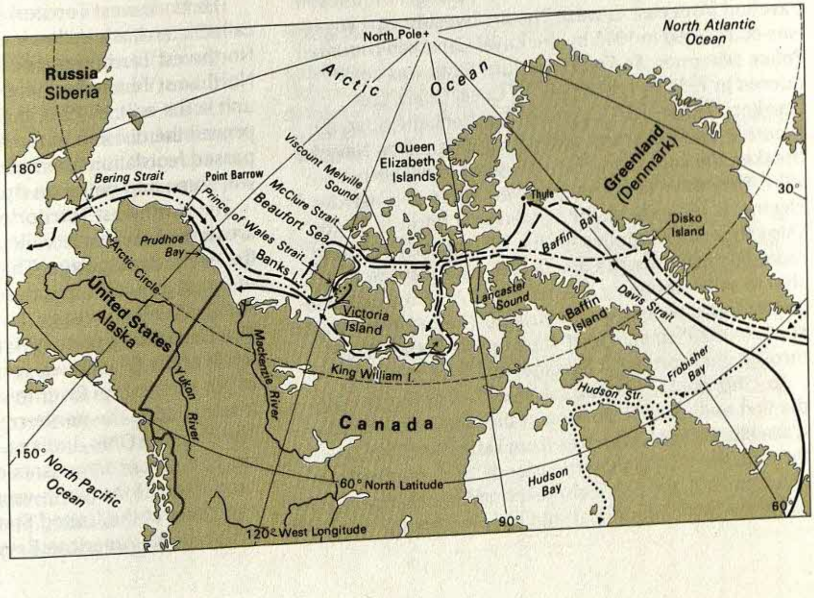
Jacques Cartier, while exploring for France in 1535, found the St. Lawrence River. He was seeking a route to China. Henry Hudson was sent out many years later by the Dutch East India Company to find a shorter route to the South Seas. He thought he had found that route in 1609 when he sailed into New York Bay and some distance up the Hudson River. In 1610, Hudson explored the Hudson Strait and Hudson Bay while searching for the Northwest Passage.

No country tried harder than England to find the passage. Sir Martin Frobisher began a series of English expeditions in 1576. Other Englishmen continued these explorations for 300 years. These men sailed far to the north in their search. Frobisher made many important findings, including Frobisher Bay, an indentation in Baffin Island (later called Baffin Land). John Davis followed Frobisher, and sailed into the strait that now bears his name. In 1616, William Baffin and Robert Bylot sailed up Davis Strait and around the great channel that has ever since been known as Baffin Bay. Russia, Holland, and Denmark took an interest in the search.

By the close of the 1700's, the territory that had been explored included Hudson Strait, Hudson Bay, Davis Strait, Baffin Bay, and the icy seas from Greenland to Spitsbergen and from Spitsbergen to Novaya Zemlya. See **Exploration.**

The Northwest Passage

This map shows routes travelled by explorers in search of a northern sea passage between Europe and Asia.



Coloured lithograph (1854) by Lt. S. Gurney Cresswell

The *Investigator,* a ship captained by the British explorer Sir Robert McClure, sailed to the north shore of Banks Island, *left,* in 1850. There, thick ice prevented further sailing. But McClure and his crew continued by sledge and ship, completing the first expedition through the Northwest Passage in 1854.

Commander John Ross, a Scottish explorer, began the final series of expeditions in 1818. The most noted of the explorers to follow him was Sir John Franklin, a British explorer. Franklin found a passage to Asia during a voyage from 1845 to 1847. His ships reached King William Island, near waters that led directly to the Asian shore. But Franklin and his crew died after their ship became jammed in the ice, and their discovery was not known until later expeditions found relics of their trip. In 1850, Sir Robert McClure, a British explorer, sailed through a passage to the northern shore of what is now Banks Island. Thick ice halted his voyage. But McClure and his crew continued their expedition by sledge and ship and, in 1854, completed the first journey through the Northwest Passage.

In 1906, Roald Amundsen's ship, the *Gjöa,* completed the first trip through the Northwest Passage. Amundsen travelled from east to west. The first west-to-east voyage was completed in 1942 by the Royal Canadian Mounted Police schooner, *St. Roch.* McClure Strait was conquered in 1954 by U.S. Navy and Coast Guard icebreakers. Three U.S. Coast Guard cutters, the *Spar,* the *Bramble,* and the *Storis,* aided by the Canadian Navy icebreaker, the *Labrador,* made the west-to-east trip in 1957. They travelled through *Bellot Strait.* This narrow channel is big enough for freighters. It permits cargo ships to unload supplies for the Distant Early Warning radar line in Northern Canada. The *Spar* was the first ship to sail completely around North America on a continuous voyage. It started in Bristol, Rhode Island, went south to the Panama Canal, then up the Pacific Coast, through the Northwest Passage, and back to Bristol.

In 1960, the U.S. atomic submarine *Seadragon* made the first underwater crossing of the Northwest Passage. It travelled 1,368 kilometres from Lancaster Sound, through the Canadian Arctic islands, and into McClure Strait. In 1969, the U.S. icebreaker-tanker *Manhattan* became the first commercial ship to complete the passage. The *Manhattan* sailed to Alaska by way of the Prince of Wales Strait.

Related articles in ***World Book*** include:

Amundsen, Roald
Arctic Ocean (Exploration of the Arctic Ocean)
Baffin, William
Cabot (Sebastian)
Cartier, Jacques
Davis, John
Franklin, Sir John
Frobisher, Sir Martin
Gilbert, Sir Humphrey
Hudson, Henry
McClure, Sir Robert
Parry, Sir William Edward

Northwest Territories is a vast region that covers about a third of Canada. It stretches from the northern boundaries of the Canadian provinces to within 800 kilometres of the North Pole. The Northwest Territories has a population of about 58,000. The population includes whites, Eskimos, Indians, and *métis* (people of mixed white and Indian descent).

The Northwest Territories is a political unit of Canada called a territory. Yellowknife serves as the capital of the Northwest Territories. For many years, Eskimos of the Northwest Territories have called for their own political unit in the east. In 1993, the Canadian Parliament approved the division of the Northwest Territories and passed legislation to create Nunavut. The new territory will come into being on April 1, 1999.

The Northwest Territories has three geographic areas: the Mackenzie Valley, the Arctic Mainland, and the Arctic Archipelago. The *tree line,* the northern limit of forest growth, separates the Mackenzie Valley and Arctic Mainland areas.

Northwest Territory was a vast tract of land lying north of the Ohio River, west of Pennsylvania, and east of the Mississippi River in what is now the United States. It extended to the northern limits of the United States. The states of Ohio, Indiana, Illinois, Michigan, Wisconsin, and part of Minnesota east of the Mississippi were carved out of the Northwest Territory. The land became a territory of the United States after the defeat of the British in the American Revolution (1775-1783).

Norway is known for the scenic beauty of its rugged mountains and its deeply indented coast. Many inlets of the sea, called *fiords,* extend far into the country. The village of Stryn on the Nord Fiord, *above,* lies about 100 kilometres from the coast.

Norway

Norway is a long, narrow country on the northwestern edge of the European continent. The northern third of Norway lies above the Arctic Circle and is called the *Land of the Midnight Sun.* Because this region is so far north, it has long periods every summer when the sun shines 24 hours a day. Oslo, Norway's capital and largest city, is in the southern part of the country.

Most of the Norwegian people live near or along the sea. Winds warmed by the sea give the coast much warmer winters than other regions so far north, and snow melts quickly there. Even north of the Arctic Circle, nearly all of Norway's harbours are free of ice all year round. Inland areas are very much colder, and snow covers the ground much of the year. For thousands of years, the people have used skis for travel over the snow-covered ground. Today, skiing is Norway's national sport. Most Norwegians learn to ski before they even start school.

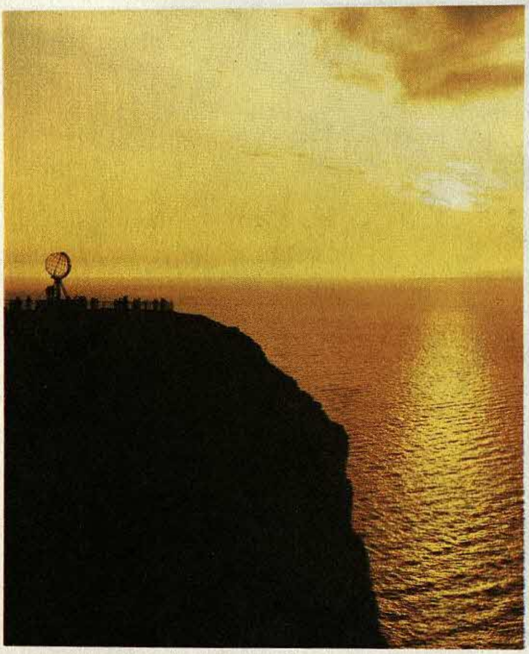
Norway, along with Denmark and Sweden, is one of the Scandinavian countries. Vikings lived in all three countries about a thousand years ago. Vikings from Norway sailed west and established colonies in Iceland and Greenland. About A.D. 1000, Leif Ericson sailed from Greenland and headed what was probably the first European expedition to the mainland of America.

Since the time of the Vikings, the Norwegians have been a seafaring people. Norway's coast is famous for its many long, narrow inlets of the sea called *fiords,* which provide fine harbours. Rich fisheries lie off the west coast, and dried fish were an important export as early as the 1200's. Norway began developing its great shipping fleet during the 1600's. Today, Norway's fishing and shipping industries rank among the world's largest. Forestry has traditionally played a major part in the economy of the country. Forestry is still an important industry. Commercially grown trees, such as pine, cover large sections of the lowland area.

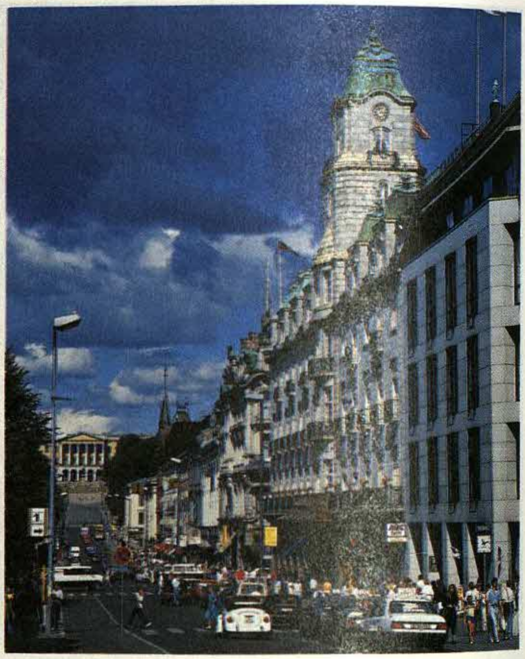
Norway is mostly a high, mountainous plateau covered by bare rock, and it has a relatively small amount of farmland. But the rivers that rush down from the mountains provide much cheap electricity. Norway generates more hydroelectric power per person than any other

Facts in brief about Norway

Capital: Oslo.
Official language: Norwegian (Bokmål and Nynorsk).
Official name: *Kongeriket Norge* (Kingdom of Norway).
Area: 386,958 km², including Svalbard and Jan Mayen. *Greatest distances*—northeast-southwest, 1,752 km; northwest-southeast, 430 km. *Coastline*—2,650 km.
Elevation: *Highest*—Galdhøppigen, 2,469 m above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 1996 population*—4,382,000; density, 11 people per km²; distribution, 77 per cent urban, 23 per cent rural. *1990 census*—4,247,546. *Estimated 2001 population*—4,508,000.
Chief products: *Agriculture*—barley, hay, livestock, milk, oats, potatoes. *Fishing*—capelin, cod, herring, mackerel. *Forestry*—timber. *Manufacturing*—aluminium, chemicals, processed foods, refined petroleum products, ships, wood pulp and paper. *Mining*—ilmenite, iron ore, lead, molybdenite, petroleum and natural gas, pyrites, zinc.
National anthem: "Ja, vi elsker dette landet" ("Yes, We Love This Land").
National holiday: Constitution Day, May 17.
Money: *Currency unit*—Norwegian krone. One krone=100 øre.



The midnight sun is a famous symbol of Norway. It shines 24 hours a day for 10 weeks each year at North Cape, *above,* a rocky point of land on the shore of the Arctic Ocean.



Oslo, *above,* Norway's capital and largest city, is home to almost 1 in 8 Norwegians. Oslo is also the chief commercial, industrial, and shipping centre of Norway.

country. Norwegian manufacturing is based on this cheap power. Important products of Norway include chemicals, metals, petroleum, processed foods, and wood pulp and paper.

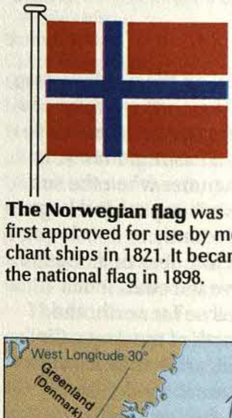
Government

Norway is a constitutional monarchy with a king or a queen, a Cabinet led by a prime minister, and a parliament. The government is based on the Norwegian Constitution of 1814, which divides the government into three branches—executive, legislative, and judicial. The prime minister is the actual head of the government. The monarch has little power.

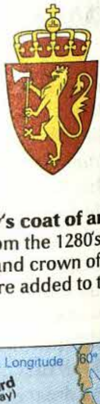
The monarch usually appoints the leader of the strongest political party or *coalition* (group of parties) in the parliament to be prime minister. Other high government officials, including judges and county governors, are appointed by the monarch on the advice of the Cabinet. Like the other Scandinavian countries, Norway has a government official called an *ombudsman.* This official investigates complaints by citizens against government actions or decisions. See **Ombudsman.**

National government. Executive power in the Norwegian government is exercised by the Cabinet, also known as the Council of State. It consists of the prime minister and about 18 other officials, each of whom heads a department or ministry. The monarch officially appoints the Cabinet members, but they are actually selected by the party or coalition in power in the parliament. In order to keep separate the powers of the executive and legislative branches, a Cabinet member cannot also be a member of the parliament.

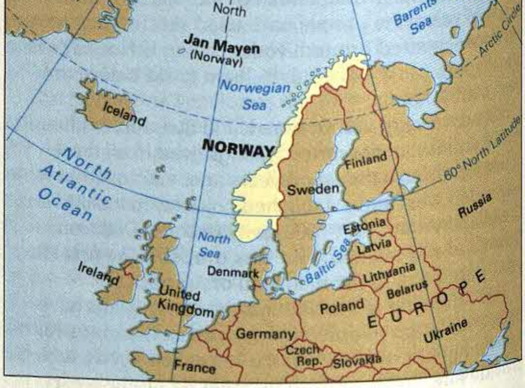
The Cabinet is responsible for forming government policies. The individual ministers carry out the policies



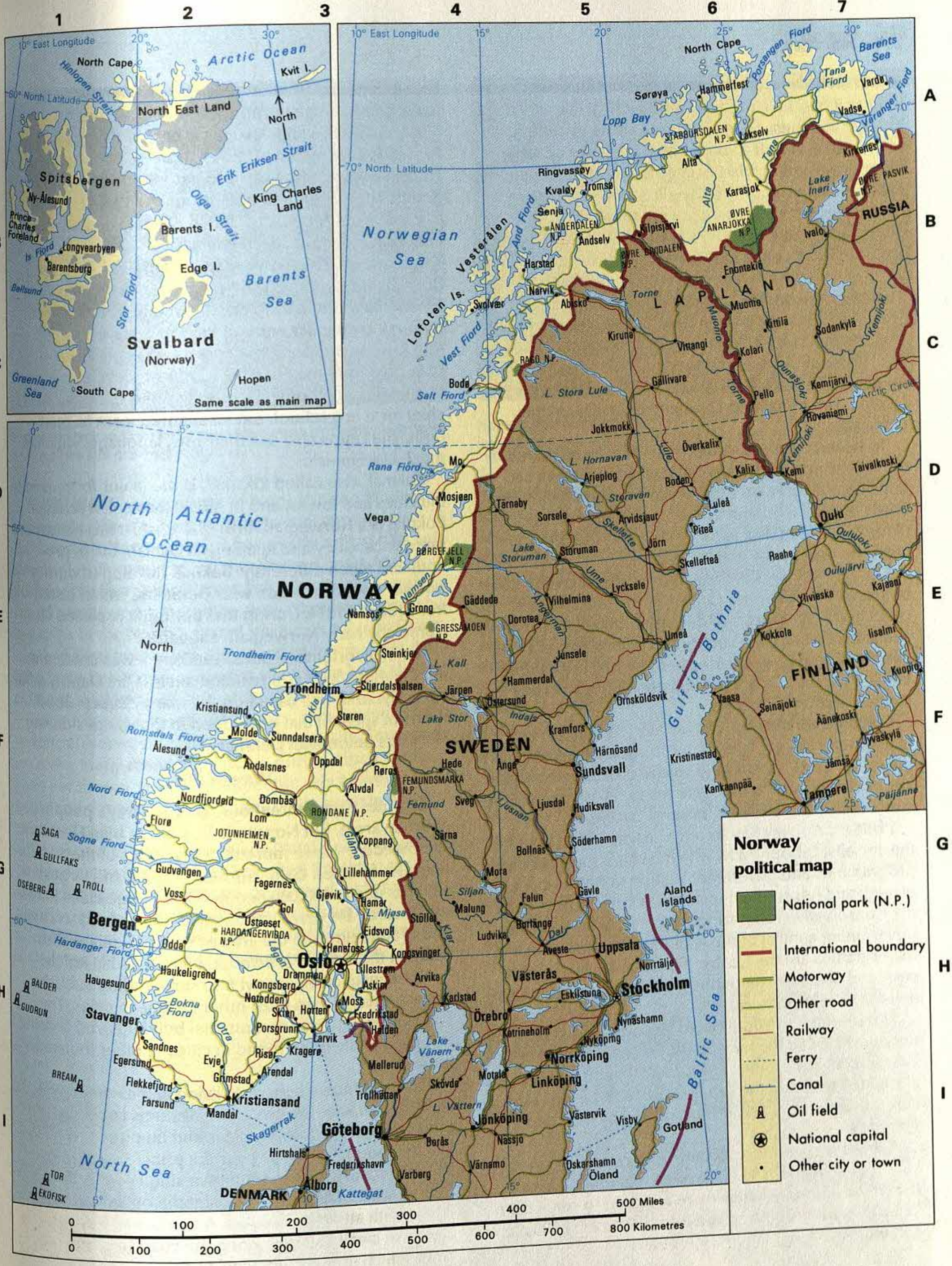
The Norwegian flag was first approved for use by merchant ships in 1821. It became the national flag in 1898.



Norway's coat of arms dates from the 1280's, when the axe and crown of Saint Olav were added to the lion.



Norway is a country in northern Europe. It borders Sweden, Finland, and Russia.



Norway map index

Cities and towns

Alesund	35,712	F	2
Alta	14,831	A	6
Arendal	12,347	I	2
Askim	12,879	H	3
Bergen	211,866	G	1
Bodø	36,352	C	4
Drammen	51,892	H	3
Egersund	12,394	I	2
Eidsvoll	16,634	H	3
Farsund	9,357	I	2
Flekkefjord	8,776	I	2
Florø	9,853	G	2
Fredrikstad	26,577	H	3
Gjøvik	26,134	G	3
Grimstad	15,507	I	2
Halden	25,827	H	3
Hamar	16,132	G	3
Harstad	22,343	B	5
Haugesund	27,549	H	1
Kongsberg	21,170	H	3
Kongsvinger	17,504	H	3
Kragerø	10,773	H	3
Kristiansand	64,926	I	2
Kristiansund	17,169	F	2
Larvik	37,979	H	3
Lillehammer	22,764	G	3
Mandal	12,475	I	2
Molde	22,095	F	2
Moss	24,659	H	3
Namsos	11,830	E	3
Narvik	18,539	C	5
Notodden	12,486	H	3
Oslo	457,818	H	3
Porsgrunn	31,196	H	3
Ringerike*	27,288	H	3
Sandefjord*	35,936	H	3
Sandnes	44,255	H	2
Sarpsborg*	11,777	H	3
Skien	47,701	H	3
Stavanger	97,716	H	1
Steinkjer	20,591	E	3
Tønsberg*	31,261	H	3
Tromsø	50,492	B	5
Trondheim	137,408	F	3
Voss	14,035	G	2

*Does not appear on map; key shows general location.
Source: 1990 official estimates.

within their departments. A Cabinet remains in office as long as it has the support of a majority of the parliament. The Cabinet must resign if it loses a vote of confidence in the parliament. If a vote of no confidence or some other government crisis occurs, an alternate Cabinet—usually from a minority party—is appointed to govern during the rest of the parliament's term.

The parliament, Norway's lawmaking body, is called the *Storting.* It consists of 165 members elected to four-year terms. Each of Norway's 19 counties elects 4 to 15 members, depending on its population. An additional eight members are chosen from national electoral lists. The Storting consists of one house. But after each election, its members form two sections to discuss and vote on proposed laws. They elect 39 of their number to the *Lagting.* The remaining 126 members make up the *Odelsting.*

To become law, most bills must first be approved by the Odelsting and then by the Lagting. If the two sections do not agree on a bill, it can be approved by two-thirds of the parliament as a whole. Certain matters, including bills that deal with taxation and spending, are voted on only by the entire parliament.

Courts. Norway's highest court is the Supreme Court of Justice. Five Superior Courts try the most serious cases and hear appeals of decisions made by the county and town courts. Each county and town also has a Conciliation Council, which tries to settle disputes before they go to court. This body consists of three people elected to four-year terms.

Local government. Norway has 19 counties, 1 of which is the city of Oslo. Each county, except Oslo, has a governor. Cities, towns, and village districts elect councils of varying size to four-year terms. These councils select a chairman, or mayor, to serve two years.

Politics. Norway has six major parties. The largest is the socialist Labour Party, which favours social welfare programmes and government action to foster economic growth and full employment. The second largest party, the Conservative Party, supports lower taxes and less government control of the economy. Norway's other major parties are the Centre, Christian People's, Progress, and Socialist Left parties. All Norwegians who are at least 18 years old can vote.

The Labour Party dominated Norwegian politics from the mid-1930's to the mid-1960's, except during World War II (1939-1945). Since then, control of the Cabinet has alternated between the Labour Party and various nonsocialist coalitions, which are usually led by the Conservative Party.

Armed forces. Norway's army, navy, and air force have a total of about 34,000 troops. Norwegian men between the ages of 19 and 44 are required to serve from 12 to 15 months in the armed forces. About 85,000 men and women serve in the Home Guard.

People

Population and ancestry. Norway has a population of about 4 million. The Norwegians are a Scandinavian people, closely related to the Danes and the Swedes. The people of Norway have strong ties with Americans. During the late 1800's and early 1900's, more than 600,000 Norwegians migrated to the United States in search of better job opportunities. No other country except Ireland has provided the United States with so many immigrants in proportion to population.

About 20,000 Lapps live in far northern Norway (see **Lapland**). That region also has about 10,000 people of Finnish ancestry. Norway also has about 135,000 immigrants. They include people from Iran, Pakistan, and Turkey, and from Africa, the United States, Southeast Asia, and from other European nations.

Language. The Norwegian language has two forms—Bokmål and Nynorsk. They are gradually being combined into a single form called Samnorsk. Bokmål and Nynorsk are similar enough for someone who speaks either form to understand a person who speaks the other. Both belong to the Scandinavian group of Germanic languages. Local school boards may select either as the chief form in a school, but all children learn to read both. The Lapps also use their own language, which is much like Finnish.

Bokmål, also called Riksmål, is the major form used in the cities and towns, and in most Norwegian schools. Bokmål is a Norwegian form of Danish. It has almost the same vocabulary and spelling as Danish, but is pronounced much differently. Bokmål developed during Norway's political union with Denmark, which lasted from 1380 to 1814. During that period, it replaced Old Norse, the early Norwegian language.

Nynorsk, originally called Landsmål, was created during the mid-1800's as a reaction against the Danish influence. Nynorsk was based on the many *dialects* (local forms of speech) that developed in the villages during Norway's union with Denmark.

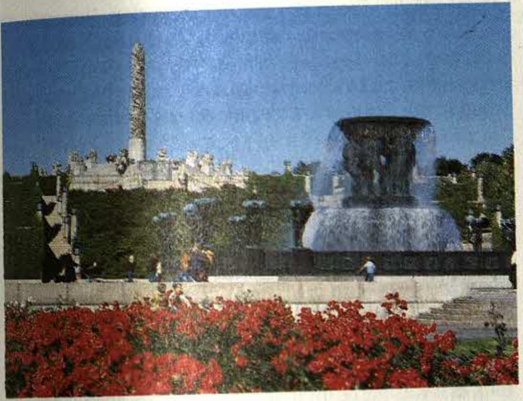
Way of life

City life. About three-fourths of Norway's people live in urban areas. But Norway is less urban than Denmark and Sweden, where more than four-fifths of the populations live in cities. Oslo, Norway's capital and largest city, has nearly 500,000 people. Other large cities in Norway include Bergen, Drammen, Kristiansand, Stavanger, and Trondheim. See the articles on Norwegian cities listed in the *Related articles* at the end of this article.

Norwegian cities sprawl into surrounding suburbs but are smaller than most other European cities. They have fewer high-rise commercial buildings and lack the fast pace of life often found in cities of other industrial nations.

Norway's high standard of living and its social welfare system have kept the cities free of slums and substandard housing. Most Norwegians and immigrant workers live in modern flats in or near the principal urban areas. Wealthier Norwegians often own single-family homes built of wood. Many people paint the outside of their house with attractive colours. A number of Norwegians also own small cottages along the coast or in the mountains, which they visit on weekends.

Although Norway's cities have bus and train services, traffic congestion is a problem for urban dwellers. Norway has little industrial pollution because of its extensive use of hydroelectric power and natural gas in industry. Unemployment is extremely low by international standards. Many of Norway's immigrants work in low-paid jobs in the cities. Their presence has caused discontent among some Norwegians because of the benefits the immigrants receive through the welfare system.



Frogner Park in Oslo has about 150 works by Gustav Vigeland, one of Norway's greatest sculptors.

Norwegian fishermen process a catch of fish, *above.* The fishing industry provides a livelihood for many rural Norwegians.

Rural life. About a fourth of Norway's people live in rural areas. The rural population is concentrated in southeastern Norway, which has gently rolling hills suitable for farming, and along the western coast. Many people who live in rural areas fish for a living. Some spend weeks or even months away from home on fishing ships in the North Sea and the North Atlantic Ocean.

Many rural homes are old, wooden farmhouses that have been modernized. Almost all of them have electric cookers, refrigerators, and other appliances.

Norway's numerous fiords, rivers, and mountains prevent rural Norwegians from travelling easily. Snow and ice make many roads impassable during much of the year. For these reasons, rural people rely heavily on boats and the country's electrified railway system for transportation.

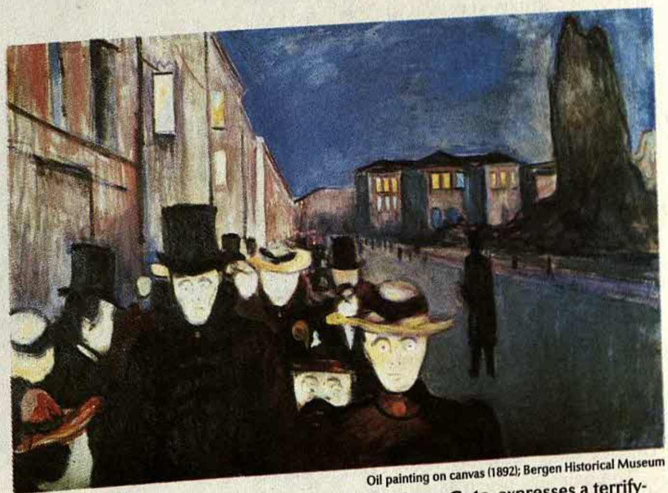
Food and drink. Norwegians usually eat four meals a day, but many farm families have five. Breakfast generally includes cereal and open-faced sandwiches with cheese, jam, herring, marmalade, or sliced meat. Goat cheese is a favourite sandwich spread. Sandwiches are also eaten at lunch and at a late-evening supper. Dinner is usually the only hot meal of the day. It includes soup, meat or fish, potatoes, vegetables, and dessert. People in the cities and towns eat dinner in the evening, and those in farm areas have it at midday.

Norwegians drink coffee throughout the day and especially at mealtimes. Many Norwegians also enjoy beer, which is sometimes served with a strong, colourless liquor called *aquavit.* Tea, milk, and soft drinks also are popular in Norway.

Recreation. Outdoor sports are an important part of Norwegian life. Recreation areas lie within short distances of all homes. Skiing, Norway's national sport, may have started there thousands of years ago as a means of crossing the snow-covered land. Many Norwegians take cross-country ski trips to the country's mountains or wooded hills. Almost every town has a ski jump. The second most popular winter activity is ice-skating. Norwegians also have long enjoyed *bandy,* a form of hockey played by 11-player teams on large rinks. Soccer is the favourite summer sport.

Norway's forests and mountains provide many other recreational opportunities. On weekends, many Norwe-

Championship ski-jumping at Holmenkollen, *above,* attracts thousands of spectators each year. Skiing is Norway's national sport.



Oil painting on canvas (1892); Bergen Historical Museum

Edvard Munch's painting *Evening on Karl Johans Gate,* expresses a terrifying sense of isolation in the characters on a crowded street in Oslo. Munch was a strong influence on the expressionist art style of the early 1900's.

gians enjoy hiking through hills and forest areas. Some Norwegians travel to cabins in the mountains, where they may spend several weeks during the summer holiday season. Many adults also enjoy hunting. Sailing is popular along the coast. In addition, Norway's numerous fiords, lakes, and rivers attract many fishing enthusiasts. Swimming is also a popular activity.

Social welfare. The government of Norway provides the people with many welfare services. All families with more than one child receive a yearly allowance for each youngster under the age of 16, beginning with the second one. These families also may receive financial aid in paying their rent. The government guarantees all employed people an annual four-week holiday with full pay. Large families with medium or low incomes pay little or no national taxes, and their local taxes are reduced.

The National Insurance Act, which went into effect in 1967, combined many existing welfare programmes. All Norwegians are required to take part in this combined scheme. It includes old-age pensions, job retraining, and aid for mothers, orphans, widows, widowers, and handicapped people. Another insurance scheme provides free medical and hospital care, in addition to cash payments to employees during periods of illness. The costs of these schemes are shared by the insured people, their employers, and the national and local governments.

Religion. The Norwegian Constitution establishes the Evangelical Lutheran Church as the nation's official church, but other religions have complete freedom of worship. About 88 per cent of the people are Evangelical Lutherans. The government largely controls the Evangelical Lutheran Church. It appoints the pastors and church officials and pays their salaries. Other religious groups in Norway include members of the Baptist, Free Lutheran, Methodist, Pentecostal, and Roman Catholic churches.

Education. Almost all the people of Norway can read and write. Norwegian law requires children from the age of 7 to 16 to go to school. The primary school programme lasts six years. It is followed by three years of junior secondary school and three years of senior secondary school. Senior secondary school provides academic courses for those who wish to go on to college and also vocational courses.

Bergen, Oslo, Tromsø, and Trondheim each have a university. Schools of higher education also include a network of regional colleges, and several technical and other specialized institutions.

The University of Oslo Library is the largest library in Norway. Oslo also has the country's largest city library. All cities and towns are required by law to have free public libraries. These libraries are partly supported by government grants.

Arts. Norwegians have contributed much to the development of the arts. Henrik Ibsen's realistic plays of the late 1800's brought him worldwide fame as the father of modern drama. Three Norwegian writers—Bjørnstjerne Bjørnson, Knut Hamsun, and Sigrid Undset—have won the Nobel Prize for literature.

The painter Edvard Munch was a strong influence on the expressionist art style of the early 1900's. Statues by Gustav Vigeland, perhaps Norway's greatest sculptor, stand in Oslo's Frogner Park. Edvard Grieg, Norway's best-known composer, used melodies from Norwegian folk songs and dances in his orchestral works. For more information on Norwegian artists, see the biographies listed in the *Related articles* at the end of this article.

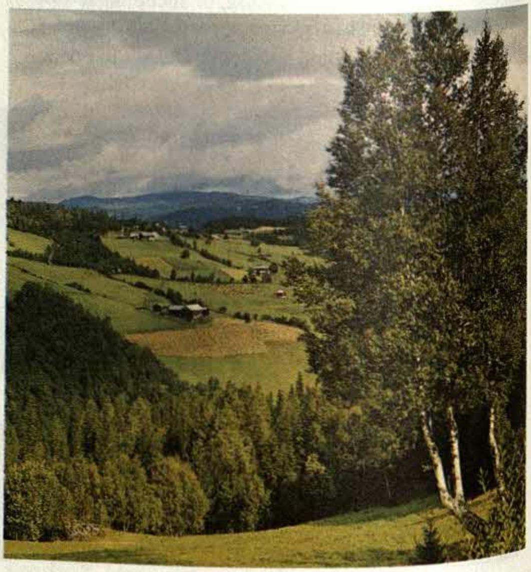
Land

Land regions. Most of Norway is a high, mountainous plateau. Its average height is more than 457 metres above sea level. Only about a fifth of Norway, including two major lowlands, lies lower than 150 metres. Norway has three main land regions: (1) the Mountainous Plateau, (2) the Southeastern Lowlands, and (3) the Trondheim Lowlands.

The Mountainous Plateau is covered largely by bare rock that was smoothed and rounded by ancient glaciers. Glaciers also formed many lakes and deep valleys, especially in the 11,700-square-kilometre Hardanger Plateau, Europe's largest highland plain. In Norway's uplands above 1,980 metres, permanent snow and ice cover about 3,110 square kilometres. The 487-square-kilometre Jostedal Glacier is the largest ice field in Europe outside Iceland.

In the narrow northern half of Norway, the Kjølen mountain range extends along the border with Sweden. Norway's highest mountains rise in the wider southern half of the country. The Dovre Mountains extend in an east-west direction, and the Long Mountains rise to the south. The Jotunheimen range of the Long Mountains includes Galdhøpiggen, northern Europe's tallest mountain, which rises to 2,469 metres.

The Southeastern Lowlands consist mostly of the middle and lower valleys of the Glåma River, which is 598 kilometres long, and several other rivers. The rivers are used to float timber to pulp mills and sawmills. Their many waterfalls provide hydroelectric energy. The region also has narrow lakes, including Lake Mjøsa.



The Trondheim Lowlands include the lower ends of several wide, flat valleys that are suitable for farming. Crops include barley and potatoes. The region also has much dairy farming.

Slopes are gentler than in most of the country, and the region is more suitable for farming and forestry. These lowlands are the most thickly settled part of Norway. They include Oslo, the capital and chief commercial, industrial, and shipping centre.

The Trondheim Lowlands include the lower ends of several wide, flat valleys. In addition to providing good farmland, the valleys also serve as important railway routes to other parts of Norway and to Sweden.

The lowlands have long been a major region of settlement. Trondheim, founded in A.D. 998, was once Norway's capital and leading city. Today, it is a leading centre of industry and trade.

Coast and islands. Many long, narrow inlets of the sea indent the rocky coast of Norway. These inlets, called *fiords,* make the coastline one of the most jagged in the world. The longest, Sogne Fiord, extends inland for 204 kilometres. Norway has a coastline of 2,650 kilometres. Including all the fiords and peninsulas, the entire length of the coast is about 21,350 kilometres, which is equal to approximately half the distance around the world.

About 150,000 islands lie off the Norwegian coast. Some are only rocky reefs called *skerries,* which shield the coastal waters from stormy seas. The Lofoten and Vesterålen islands are the largest offshore island groups. The waters around them have rich cod fisheries. The famous Maelstrom current sweeps between the two outermost Lofotens, sometimes forming dangerous whirlpools. Jan Mayen and Svalbard are island possessions of Norway in the Arctic Ocean.

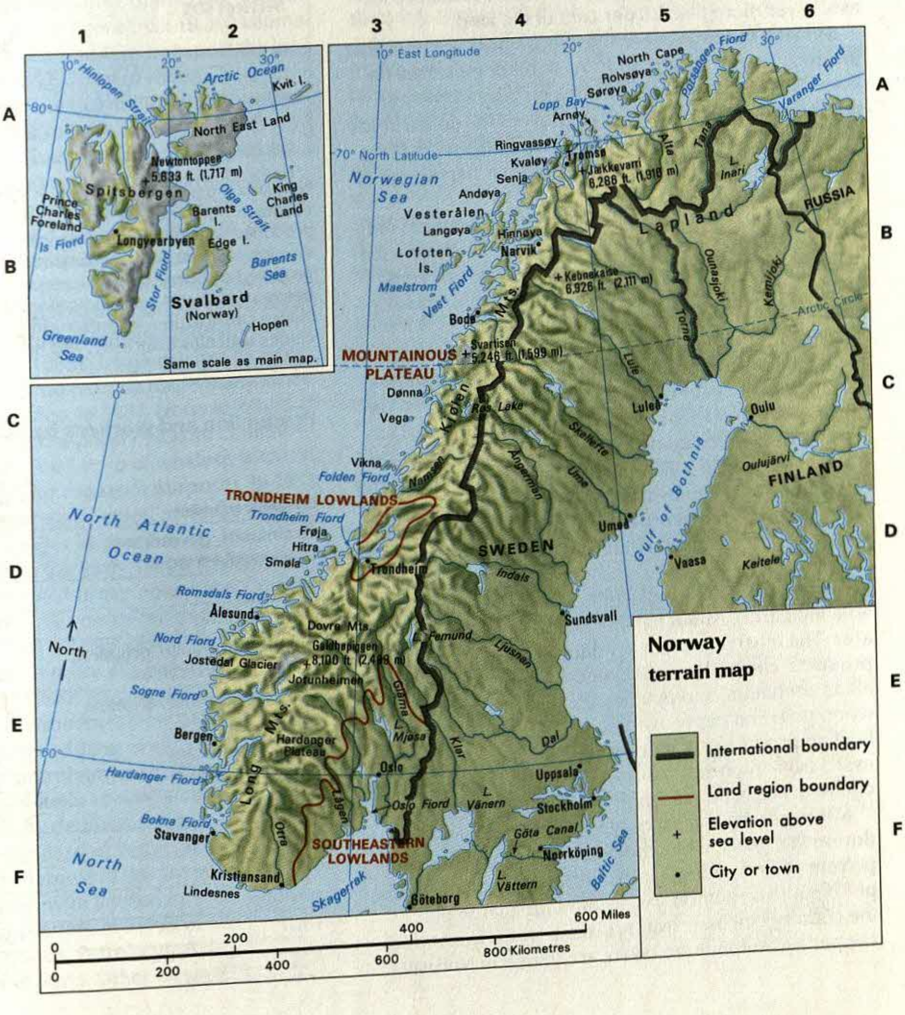
Climate

The climate of Norway is much milder than that of most other regions as far north, especially along the country's west coast. Near the Lofoten Islands, for example, January temperatures average 25 Celsius degrees higher than the world average for that latitude. Snow that falls along the coast melts almost immediately. The warm North Atlantic Current of the Gulf Stream keeps nearly all the seaports ice-free, even in the Arctic (see **Gulf Stream**).

During winter, Norway's inland regions are colder than the coast because mountains block the warm west winds from the sea. Snow covers the ground at least three months a year. During the summer months, when the sea is cooler than the land, the west winds cool the coast more than the inland. The warmest summers are in the inland valleys of the southeast. Less rain falls inland than along the coast.

Physical features

Alta River	A	5
Andøya (island)	B	4
Arnøy (island)	A	4
Barents Island	B	2
Barents Sea	B	2
Bokna Fiord	F	2
Dovre Mountains	D	3
Edge Island	B	2
Folden Fiord	C	3
Galdhøpiggen (mountain)	E	3
Glåma River	E	3
Hardanger Fiord	E	2
Hardanger Plateau	E	2
Hinlopen Strait	A	1
Hinnøya (island)	B	4
Hitra (island)	D	3
Is Fiord	B	1
Jaekkevarri (mountain)	B	4
Jostedal Glacier	E	2
Jotunheimen (mountains)	E	3
Kjølen Mountains	C	4
Kvaløy (island)	A	4
Lågen River	F	3
Lake Femund	E	3
Lake Mjøsa	E	3
Langøya (island)	B	4
Lapland	B	5
Lindesnes (cape)	F	2
Lofoten Islands	B	3
Long Mountains	E	2
Lopp Bay	A	5
Maelstrom (current)	B	3
Namsen River	D	3
Newtontoppen (mountain)	A	1
Nord Fiord	E	2
North Cape	A	5
North East Land	A	2
North Sea	F	1
Olga Strait	B	2
Oslo Fiord	F	3
Otra River	F	2
Porsangen Fiord	A	5
Ringvassøy (island)	A	4
Rolvsøya (island)	A	5
Romsdals Fiord	D	2
Røs Lake	C	4
Senja (island)	B	4
Skagerrak (channel)	F	3
Smøla (island)	D	2
Sogne Fiord	E	2
Sørøya (island)	A	5
Spitsbergen (island)	A	1
Stor Fiord	B	2
Svalbard (islands)	B	2
Svartisen (mountain)	C	4
Trondheim Fiord	D	3
Varanger Fiord	A	6
Vega (island)	C	3
Vesterålen (islands)	B	4
Vest Fiord	B	4



The far north, known as the *Land of the Midnight Sun,* has continuous daylight from mid-May to the end of July. The period of midnight sun decreases southward, and there is no 24-hour sunshine south of the Arctic Circle. In winter, northern Norway has similar periods of continuous darkness. See **Midnight sun.**

Economy

Norway has a well-developed economy. Since the late 1940's, the nation's income from the production of goods and services has increased sharply. Unemployment has been relatively low. The rapid economic growth has resulted largely from government programmes to promote investment and industries, and from increased foreign demand for the goods and services of Norway.

Natural resources. Norway's waters provide its most valuable resources. Important petroleum and natural gas fields lie offshore in the North Sea. The offshore areas and the country's rivers are rich in fish. Norway's many swift mountain rivers are used to produce hydroelectric power.

Norway's land is not rich in natural resources. About 60 per cent of the country consists of mountains and plateaus that are covered mostly by bare rock. Only about 3 per cent of Norway is farmland. Productive forests cover more than 20 per cent of the land.

Service industries are those economic activities that produce services, not goods. As in other industrial nations, Norway's service industries employ a growing number of workers. In 1960, employees in service industries accounted for about 45 per cent of the work force. Today, these activities employ more than 70 per cent of Norway's workers.

Community, government, and personal services employ 40 per cent of Norway's workers and include such activities as education, health care, and government. Other service industries include banking, communication, insurance, trade, and transportation.

Manufacturing developed much later in Norway than in the major industrial countries. Those countries had their own coal to provide power with which to run machines. In the 1800's, Norway had to import coal for its factories, which made manufacturing costly and held back its growth. By 1900, Norway had started to develop its sources of cheap hydroelectric power. The country's factories turned to hydroelectricity to meet their power needs. As a result, manufacturing in Norway expanded rapidly.

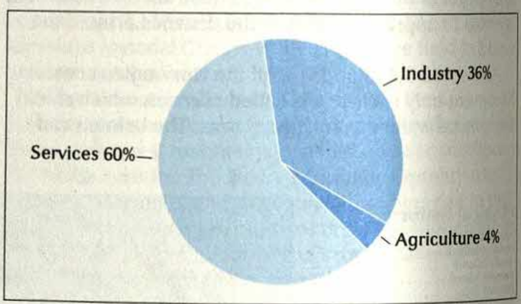
Today, manufacturing is one of Norway's most valuable industries. About half the factories are in the Oslo area. The most important products include petroleum products, chemicals and chemical products, such metals as aluminium and magnesium, processed foods, and wood pulp and paper. Norway is one of the world's leading producers of aluminium. This metal is processed from imported bauxite. The nation also produces clothing, electrical machinery, furniture, and ships.

Mining became a major Norwegian economic activity during the 1970's, when the country began producing petroleum and natural gas from North Sea fields. Today, petroleum and natural gas account for a large part of the country's income. Iron ore and pyrites, from which copper and sulphur are taken, are mined in Norway. Other minerals include ilmenite, lead, molybdenite, and zinc. Coal is mined only in Svalbard, an island territory north of Norway.

Agriculture. Farms in Norway lie on narrow strips of land in inland valleys and along the coast. About two-thirds of the country's farms cover 10 hectares or less. Many Norwegian farmers have a second occupation so they can earn enough to support their families. Farmers own about two-thirds of Norway's commercial forests, and many are also loggers. Some farmers also fish commercially.

Dairy farming and livestock production account for over two-thirds of Norway's farm income. Most cropland is used to grow livestock feed. The major crops of Norway are barley, fruit and vegetables, hay, oats, and potatoes.

Norway's gross domestic product

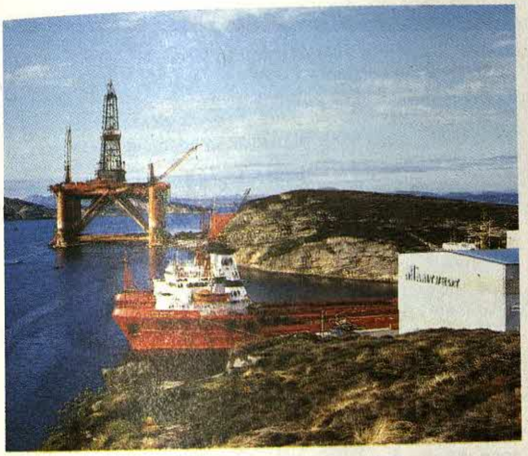


Norway's gross domestic product (GDP) was 103,400,000,000 U.S. dollars in 1993. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, property, and business services; trade, restaurants, and hotels; transportation and communications; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Per cent of GDP produced	Employed workers: Number of people	Employed workers: Per cent of total
Community, government, & personal services	22	804,600	40
Mining	18	23,600	1
Manufacturing	14	288,300	14
Finance, insurance, property, & business services	14	146,400	7
Trade, restaurants, & hotels	11	330,000	16
Transportation & communication	9	177,300	9
Construction	4	122,000	6
Utilities	4	19,700	1
Agriculture	2	91,200	5
Fishing	1	18,600	1
Forestry	1	6,800	*
Total	100	2,028,500	100

*Less than one-half of 1 per cent.
Figures are for 1993.
Source: Statistics Norway.



Norway possesses rich petroleum and natural gas deposits in the North Sea. Exports of petroleum and natural gas have greatly stimulated Norway's economy.

Hydroelectric plants, such as the Alta River dam, *above,* harness the energy of Norway's many swiftly flowing rivers. The plants provide inexpensive power for homes and industry.

Forestry has been an important industry in Norway for hundreds of years. Lumber became a major export during the 1500's. Today, much timber is also used to produce pulp and paper. The chief commercial trees include birch, pine, and spruce. More than 19,300 kilometres of forest roads have been built to transport the logs. Much timber is also moved by way of rivers.

Norwegian loggers cut over 10 million cubic metres of timber a year. The forest growth rate is about 19 million cubic metres a year. Timber production could not be increased much without using up the forests, all of which are protected by government regulations.

Fishing. Norway has long been an important fishing country. Its total catch is about 1.8 billion kilograms a year. Norwegian fishing crews bring in cod, haddock, herring, and mackerel. Much of the catch is processed for export. Norway's once-great whaling industry declined sharply during the 1960's. Large catches by Norway and other major whaling nations made many kinds of whales increasingly scarce. In 1987, Norway joined an international *moratorium* (temporary halt) on commercial whaling (see **Whale** [The future of whales]). It continued to take some whales for research purposes. In 1993, Norway resumed commercial whaling of minke whales, claiming they were no longer in danger.

Energy sources. Since the early 1900's, hydroelectric stations have generated most of the power used in Norway's industry and homes. But since the mid-1970's, the extraction of Norway's rich oil and natural gas deposits in the North Sea has led to more extensive use of petroleum products in industry and transportation. About half of the energy Norway consumes is now generated by hydroelectric power. About 40 per cent of the country's energy is produced by petroleum products, and about 10 per cent by such solid fuels as coal, peat, and wood.

Foreign trade. Norway depends heavily on foreign trade to help keep its standard of living high. The nation's trade is one of the largest in the world in relation to its population. Norway, with limited natural resources, imports a wide variety of foods and minerals as well as manufactured goods. Petroleum and natural gas rank as Norway's chief exports. Other exports include chemicals, fish, machinery, metals, transportation equipment, and wood pulp and paper. Norway's merchant fleet, one of the largest in the world, is also an important source of income for the country. The fleet provides shipping services for countries in all parts of the world.

Norway's leading trade partners are Sweden, Germany, and the United Kingdom. Norway also trades with other European countries, especially Denmark, the Netherlands, and France, and with the United States.

Transportation. During World War II (1939-1945), about half of Norway's merchant fleet was sunk while carrying cargo for the Allies. After the war, the fleet grew to become one of the world's largest. Several hundred vessels link the coastal cities and towns of Norway. Inland, ferries cross many fiords and rivers.

Norway has an extensive road system. Only the major routes are paved, but most of the others have well-kept gravel surfaces. Almost all households own a car.

The government owns and operates nearly all the railways. It also owns part of the Scandinavian Airlines System, which flies throughout the world. Several airlines provide regular service to all parts of Norway. The country's chief airports are in Oslo, Bergen, and Stavanger.

Communication. Norway has about 80 daily newspapers. The most important daily papers include the *Aftenposten, Arbeiderbladet, Dagbladet,* and *Verdens Gang* of Oslo; the *Bergens Tidende* of Bergen; and the *Adresseavisen* of Trondheim. Many of the country's newspapers support the views of one of the major political parties.

The government-owned Norwegian Broadcasting Corporation operates the country's radio and television systems. No advertising is allowed on the programmes. The corporation's income is provided by annual taxes on all radio and television sets in the country. Most radio and television programmes are cultural or educational, and less than a third of the broadcasting time is used for entertainment. Norway has an average of 1 radio for every person and 1 television for every 3 people.

The government owns and operates the telegraph system and most telephone services. Telegraph and telephone lines connect all sections of Norway.

History

Early days. Almost 11,000 years ago, people lived along the northern and western coasts of what is now Norway. Most of the region was covered by thick ice sheets, which took thousands of years to melt. By 2000 B.C., a series of Germanic tribes had started to settle there permanently. They gradually spread throughout the region, and continued to arrive for hundreds of years after the time of Christ. The tribes formed local and regional communities ruled by chiefs and kings.

The Viking period. Viking sea raiders from the Norwegian communities spread terror through much of western Europe for about 300 years. Beginning with the British Isles about A.D. 800, they attacked coastal towns and sailed away with slaves and treasure. The Vikings also sailed to the west and established colonies in the Faeroe Islands and other North Atlantic islands. About 870, they explored farther west and colonized Iceland. Eric the Red brought the first group of settlers to Greenland about 985. About 1000, his son, Leif Ericson, led what is believed to have been the first voyage of Europeans to the mainland of America. See **Eric the Red; Ericson, Leif; Vikings** (The Norwegian Vikings).

About 900, much of present-day Norway was united under Norway's first king, Harold I (called Fairhair), or Harald I. He defeated many local chieftains and kings, and others recognized his leadership. King Olav I introduced Christianity in Norway during the 990's. In the early 1000's, Olav II achieved full Norwegian unity and firmly established Christianity. He became recognized as Norway's patron saint soon after his death in 1030.

The Viking period ended during the late 1000's. The church grew in power, foreign trade expanded, and religious and trading centres became important cities. Political confusion and bitter struggles for royal power also developed. Beginning in 1130, many regional leaders claimed the throne. They were defeated in a series of civil wars that lasted until 1240. Peace was restored under Haakon IV. By 1300, Norway's economy was largely controlled by north German merchants. Norway had become dependent on them for grain imports. The country was weakened further in 1349 and 1350, when about half the Norwegian people died in an epidemic of plague.

Union with Denmark. Margaret, the wife of King Haakon VI of Norway, was also the daughter of the king of Denmark. After her father died in 1375, she had her young son elected king and she ruled Denmark as regent. Haakon died in 1380, and Margaret became regent of Norway as well. In 1388, during political confusion in Sweden, Swedish noblemen elected her to rule that country, too. In 1397, in the Union of Kalmar, Margaret united Norway, Denmark, and Sweden, with power centred in Denmark. Sweden revolted against the Danish rule several times, and broke away from the union in 1523.

Under the Danish-controlled union, Norway grew weaker and Denmark became stronger. In 1536, Denmark declared Norway a Danish province and made Lutheranism the official Norwegian religion.

During the 1500's, Norway exported increasing amounts of timber to the countries of western Europe. As a result, Norway began to develop a great shipping industry during the late 1600's. The industry expanded rapidly throughout the 1700's.

Important dates in Norway

c. 870 Norwegian Vikings colonized Iceland.
c. 900 Harold I united Norway.
c. 985 Eric the Red colonized Greenland.
c. 1000 Leif Ericson sailed to North America.
1349-1350 An epidemic of plague killed about half the people of Norway.
1380 Norway was united with Denmark.
1536 Norway became a Danish province. Lutheranism was made Norway's official religion.
1814 Denmark gave up Norway to Sweden but kept Norway's island colonies.
1884 The cabinet of Norway became responsible to the parliament instead of the king.
1905 Norway became independent.
1940-1945 German troops occupied Norway in World War II.
1945 Norway joined the United Nations.
1949 Norway became a member of the North Atlantic Treaty Organization.
1957 King Haakon VII died and was succeeded by Olav V.
1960 Norway and six other nations formed the European Free Trade Association.
1967 Norway began its greatest welfare programme, which combined many established social security schemes under the National Insurance Act.
1970's Norway began producing petroleum and natural gas from North Sea fields, greatly stimulating the economy.
1991 King Olav V died and was succeeded by Harald V.

Union with Sweden. In 1807, during the Napoleonic Wars, Denmark sided with France against Britain. Britain had been Norway's chief trading partner, but now the British ended the trade. British warships blockaded Norway's trade with other countries, and many Norwegians starved. Norway was cut off from Denmark by the British blockade and began to manage its own affairs. The Norwegians secretly began to trade with the British again.

Denmark was defeated in 1813 by Sweden, an ally of Britain against France. In 1814, in the Treaty of Kiel, Denmark gave Norway to Sweden. Denmark kept Norway's colonies—Greenland, Iceland, and the Faeroe Islands.

The Norwegians did not recognize the Treaty of Kiel. Later in 1814, they elected an assembly to draw up a constitution for an independent Norway. The constitu-

Norwegian Vikings sailed long wooden ships—like this one preserved in an Oslo museum—in raids along the coast of western Europe. They also explored the North Atlantic Ocean.

The Constitution of Norway was adopted in 1814 by an elected assembly at Eidsvoll, near Oslo. It has remained in effect since then with only minor changes. This painting of the assembly, presented to the parliament in 1885, hangs in the Storting's main chamber.

The National Assembly, Eidsvoll 1814 by Oscar Wergeland. Storting, Oslo

tion was adopted on May 17, but Sweden refused to grant Norway independence. Swedish forces attacked Norwegian troops and quickly defeated them. In November 1814, the Norwegian parliament accepted King Charles XIII of Sweden as Norway's ruler as well.

In 1884, after a long political struggle, the parliament won the right to force the cabinet to resign. Until that time the cabinet had been responsible only to the king.

Independence. During the 1890's, Norway's merchant fleet was one of the largest in the world. But the Swedish foreign service handled Norway's shipping affairs in overseas trading centres. Norway demanded its own foreign service, but Sweden refused. In May 1905, the Norwegian parliament passed a law creating a foreign service, but the Swedish king vetoed it. On June 7, the parliament ended the union with Sweden.

Sweden nearly went to war against Norway. However, Sweden recognized Norway's independence in September 1905, after a ballot in which all but 184 Norwegians voted for independence. In November, the people approved a Danish prince as their king. He became Haakon VII.

Norway had started to develop its many mountain streams to produce hydroelectric power. Its industries expanded rapidly with this cheap power source. Norway's economy increased further during World War I (1914-1918). Norway remained neutral, but its merchant fleet carried much cargo for the Allies. About half its ships were sunk by German submarines and mines.

An economic depression hit Norway after World War I. The economy, dependent on trade and shipping, suffered further during the worldwide depression of the 1930's. Between a quarter and a third of Norway's workers were usually unemployed during this period.

World War II began in 1939, and Norway tried to remain neutral. But on April 9, 1940, Germany invaded Norway by attacking all its main seaports at once. The Norwegians fought bravely for two months, aided by some British, French, and Polish troops. On June 10 of that year, Norway surrendered. King Haakon VII and the cabinet fled to London and formed a government-in-exile. The Germans made Vidkun Quisling, a Norwegian who supported them, premier of Norway. His last name became an international word for *traitor.*

A secret Norwegian resistance army conducted sabotage against the German occupation force. These Norwegians were trained chiefly to join a hoped-for Allied invasion of Norway. Other Norwegians fled their country and trained in Sweden or Great Britain for the invasion. Some took part in British commando raids in Norway. After each raid, the Germans shot, tortured, or imprisoned many Norwegians.

Norwegian fighter pilots were trained in Canada, and operated from bases in Britain and Iceland. Norway's merchant fleet carried war supplies for the Allies. The Norwegian navy helped protect Allied shipping, and took part in the invasion of France in 1944.

On May 8, 1945, after Germany fell, the 350,000 German troops in Norway surrendered. Haakon VII returned in triumph on June 7, the 40th anniversary of Norwegian independence. About 10,000 Norwegians died during the war, and about half the merchant fleet was sunk. The far northern counties of Finnmark and Troms lay largely in ruins. See **World War II.**

Postwar developments. After the war, U.S. loans helped Norway rebuild its merchant fleet and industries. By the 1950's, the Norwegian economy was thriving.

Norway became a charter member of the United Nations in 1945. The next year, Trygve Lie of Norway became the first secretary-general of the UN. In 1949, Norway became a charter member of the North Atlantic Treaty Organization (NATO). But Norway refused to permit NATO bases or nuclear weapons on its territory for fear of angering the Soviet Union, its neighbour on the northeast. The Soviet Union had been formed under Russia's leadership in 1922, and it existed until 1991. In 1960, Norway and six other countries formed the European Free Trade Association (EFTA), an economic union (see **European Free Trade Association**). Olav V became king of Norway in 1957.

In 1966, the parliament passed the National Insurance Act, probably the most important reform in Norway's history. The programme, which began on Jan. 1, 1967, combines such social security schemes as old-age pensions, job retraining, and aid for mothers, orphans, widows, widowers, and the handicapped.

The 1970's. In 1972, Norway signed a preliminary treaty to join the European Community, now known as the European Union (EU). The EU is an organization that promotes trade and economic cooperation among European nations (see **European Union**). The treaty was submitted for voter approval. Supporters argued that membership would benefit the Norwegian economy, while opponents feared it would threaten Norway's national identity and quality of life. In September 1972, Norway's voters rejected the membership treaty. The government then reached a more limited agreement with the European Community to eliminate tariffs on most industrial goods.

Norway began producing petroleum and natural gas from North Sea fields during the early 1970's. Since then, the extraction and processing of petroleum and gas have greatly stimulated economic growth. Norway profited from large increases in the price of oil from the mid-1970's to the early 1980's. During this period, the country's economy continued to expand and unemployment remained low, while many other nations struggled with inflation and slow economic growth.

Recent developments. After decades of Labour Party dominance in the Cabinet, Norway entered a period of rapidly shifting coalitions and governments during the 1980's. Several nonsocialist governments held power in the early 1980's, followed in 1986 by a minority government led by the Labour Party. In the 1989 elections, gains by the Progress Party and other nonsocialist parties deprived the Labour Party of control of the parliament, and a coalition led by the Conservative Party took office. In 1990, the coalition government collapsed and the Labour Party formed a new government. The Labour Party again won elections in 1993, but there was strong support for the Centre Party, which opposed EU membership.

Until 1990, only a king could serve as monarch of Norway. That year, the Storting amended the Constitution to allow women to inherit the throne. Olav V died in 1991. Harald V succeeded him as king.

Norway's economic ties with the European Community expanded after the early 1970's, and many Norwegians urged that the country join the EU. In 1994, Austria, Finland, Norway, and Sweden agreed terms with the EU to join in 1995. In a referendum in November 1994, Norwegians voted to reject EU membership.

Related articles in *World Book* include:

Biographies

Amundsen, Roald
Asbjørnsen, Peter C.
Balchen, Bernt
Bjørnson, Bjørnstjerne
Eric the Red
Ericson, Leif
Flagstad, Kirsten
Grieg, Edvard
Hamsun, Knut
Harold I (of Norway)
Harold III (of Norway)
Ibsen, Henrik
Lie, Trygve
Munch, Edvard
Nansen, Fridtjof
Olav V
Quisling, Vidkun
Undset, Sigrid
Wergeland, Henrik A.

Cities

Bergen
Oslo
Trondheim

History

Canute
Europe, Council of
Vikings
World War II

Physical features

Arctic
Barents Sea
Fiord
Lapland
Lofoten Islands
Maelstrom
Midnight sun
Skagerrak
Svalbard

Other related articles

Christmas (In Denmark, Norway, and Sweden)
Clothing (picture: Traditional costumes)
European Free Trade Association
Scandinavia
Skiing
Theatre (Scandinavia)

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  - B. Courts
  - C. Local government
  - D. Politics
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- **III. Way of life**
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  - I. Foreign trade
  - J. Transportation
  - K. Communications
- **VII. History**

Questions

What families are covered by Norway's family allowance programme?
Who led what was probably the first voyage of Europeans to the mainland of America?
How do Norway's cities differ from other European cities?
What is the northern third of Norway called? Why?
Who chooses and who appoints members of Norway's Cabinet? What role does the Cabinet play in the government?
How did Norway's two official languages develop?
Why is Norway's large merchant fleet helpful to the country's economy?
What are Norway's chief sources of energy?
When and why did mining become an important economic activity in Norway?
What led to Norway's independence from Sweden?

Norwegian elkhound is a hunting dog that originated in Norway, probably between 5000 and 4000 B.C. Hunters claim the elkhound can scent an elk 5 kilometres away. The elkhound stalks its prey quietly and holds it at bay until the hunter arrives. It is also used in hunting bear and game birds. The elkhound's coat is thick and grey with black tips. The dog weighs about 23 kilograms. See also **Dog** (picture: Hounds).

Norwich (pop. 121,000) is a city, a local government district, and the administrative centre of Norfolk, England. It stands on the River Wensum, 185 kilometres northeast of London. It is noted for its boot-and-shoe manufacturing industry and for its large cattle market. Other industries in Norwich produce confectionery and electrical equipment. The city contains the studios of an independent television company and a local radio station. It also has the headquarters of a large insurance company.

The centre of Norwich contains a great many medieval buildings, including more than 30 churches. Among the buildings are the Guildhall, dating from the early 1400's; Strangers' Hall, a merchant's house built in the 1400's; and a Norman Cathedral that has a high spire built in the Decorated style.

Norwich terrier is a breed of dog that was developed in England about 1880. Norwich terriers make fine hunting dogs because they are alert, quick, and sturdy. In England, fox hunters use them to chase foxes out of holes. The dogs are also good at catching such animals as rats and rabbits. In addition, Norwich terriers make especially affectionate pets.

The Norwich terrier originated in England.

Norwich terriers are identical to Norfolk terriers, except for the ears. The ears of Norwich terriers stand straight up. Those of Norfolk terriers bend forward. The Kennel Club in England recognized the dogs as separate breeds in 1964.

Norwich terriers may be red, black and tan, wheat-coloured, or grey. They have a straight, wiry outer coat and a thick undercoat. The dogs have short legs and their tail is *docked* (cropped) to medium length soon after birth. Full-grown Norwich terriers stand about 25 centimetres high and weigh about 5 kilograms.

See also **Norfolk terrier.**

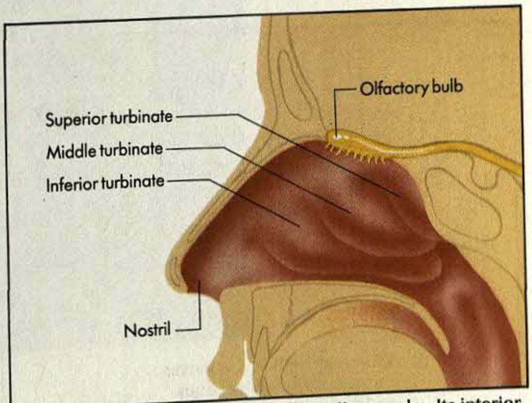
Nose is the organ used for breathing and smelling. It forms part of the face, just above the mouth. Outwardly, it seems simple, but it is complicated inside.

When we breathe, air enters the nose through two openings called *nostrils.* The nostrils are separated by the *septum,* a thin wall of *cartilage* (tough tissue) and bones. Air passes from the nostrils into two tunnels called the *nasal passages,* which lead back to the upper part of the throat. From the nasal passages, air passes through the pharynx and windpipe into the lungs.

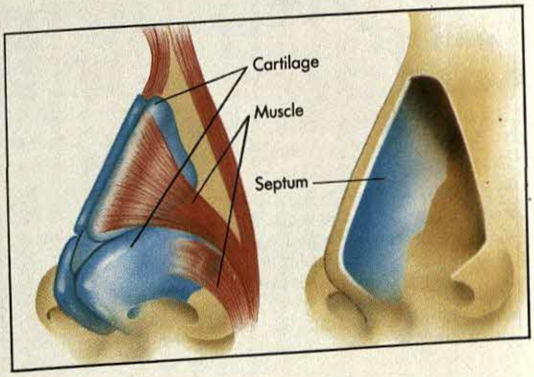
Both nasal passages have a lining of soft, moist mucous membrane covered with microscopic, hairlike projections called *cilia.* The cilia wave back and forth constantly, moving dust, bacteria, and fluids from the nose to the throat for swallowing.

Each nasal passage also has three large, shelflike bones that are called *turbinates* or *conchae.* The top two turbinate bones on each side are actually *processes* (extensions) of the *ethmoid* bone. The lowest turbinate bone on each side is a separate bone. The turbinates warm the air before it enters the lungs. These bones also stir up the air so that dust in the air sticks to the mucous membrane of the turbinates and thus does not pass into the lungs.

The perception of smell occurs in the highest part of the nasal cavity, where *olfactory nerve receptors* lie in a small piece of mucous membrane. These receptors generate nerve impulses in response to chemicals in the air. *Olfactory nerve fibres* then carry the impulses to a part of the brain called the *olfactory bulb.* One olfactory bulb lies just above each nasal passage. From there, the im-



The nose is outwardly simple but inwardly complex. Its interior, *above,* consists of two passages. Each passage contains three shelflike bones called *turbinates,* which are covered by mucous membranes. These bones help warm inhaled air. Nerve fibres extending from an *olfactory bulb* at the top of each passage contain odour-detecting *olfactory nerve receptors.* The exterior of the nose, *below left,* consists largely of an elastic tissue called *cartilage.* So also does the front-most part of the *septum,* the wall that separates the nasal passages, *below right.*



pulses are carried to other parts of the brain, where they are translated into sensations of odour.

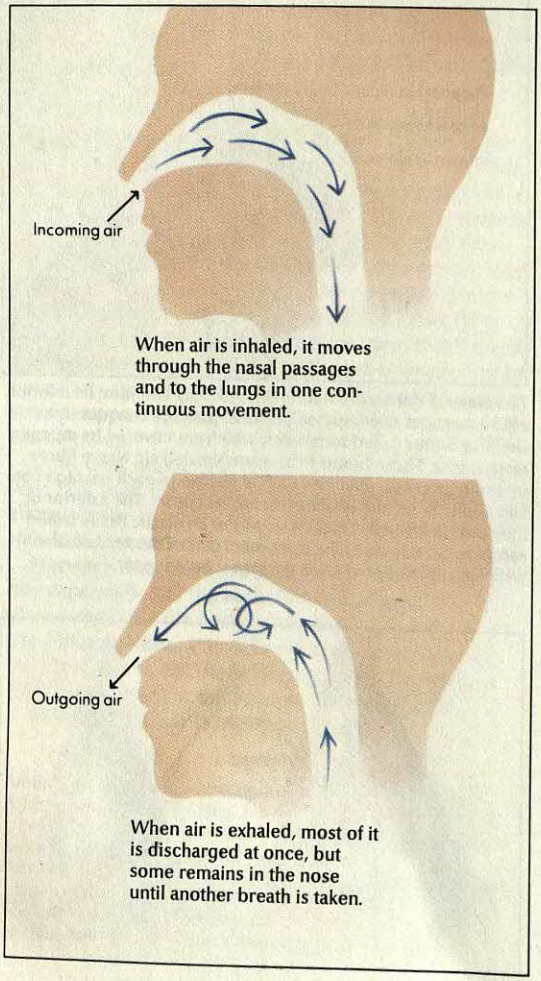
The sense of smell is closely related to the sense of taste. Some experts believe that much of our taste sensations are really sensations of odour that we have associated with certain tastes. For example, we really smell coffee, tobacco, wine, apples, and potatoes more than we taste them. If a person is blindfolded and the nose stopped up so that the person cannot smell, the person has great difficulty telling apples from potatoes by taste. Red wine and plain coffee taste almost alike to such a person when they are at the same temperature and consistency.

We cannot smell when we have a cold, because the infection inflames the mucous membrane of the nasal passages and blocks the passage of air to the centre of smell. It is important to keep nasal passages clean and to treat any inflammation of the mucous membrane at once. When neglected, colds can lead to more serious ailments, such as bronchitis and pneumonia. Sinuses, which empty into the nose, may also become infected.

Related articles in ***World Book*** include:

Adenoids
Cilia
Cold, Common
Cold sore
Mucus
Nosebleed
Respiration (with diagram)
Rhinitis
Sinus
Smell (with diagram)

How we breathe



When air is inhaled, it moves through the nasal passages and to the lungs in one continuous movement.

When air is exhaled, most of it is discharged at once, but some remains in the nose until another breath is taken.

To stop minor nosebleeds, lean forward and pinch your nostrils together for about 10 minutes.

Nosebleed is a discharge of blood from the nose. Most nosebleeds result from minor irritations of the tissue that lines the lower nasal passages. But nosebleeds may also occur as a symptom of a serious illness or as a result of a head or neck injury. The medical term for nosebleed is *epistaxis.*

The nasal passages are lined with a thin, moist tissue called *mucous membrane.* Many small vessels carry blood close to the membrane's surface. If the membrane becomes dry, even slight knocks or scratches can break the blood vessels. This type of nosebleed commonly occurs in the winter, when nasal tissues become irritated by dry, cool air and by colds and influenza.

Minor nosebleeds frequently result from irritations of the mucous membrane that covers the *nasal septum,* the structure that separates the two nostrils. Some people have a septum which curves into one of the two nostril chambers. Such a septum lies directly in the path of air entering the nose, and therefore is likely to become dried and to bleed if irritated.

To stop a minor nosebleed, sit down and lean forward. Then, pinch your nostrils together for about 10 minutes, or until the bleeding stops. Repeat if necessary, but if the nosebleed does not stop after 30 minutes, seek medical attention.

Severe nosebleeds may be associated with physical injury, fever, high blood pressure, or blood disorders. Medical advice should be sought if bleeding is severe.

Nostradamus (1503-1566) was the Latin name of Michel de Notredame, a French astrologer and doctor. His fame rests on his book *Centuries* (1555), a series of prophecies in verse. Nostradamus won lasting fame in 1559 when King Henry II of France died in a manner predicted in the *Centuries.*

Nostradamus was born in St.-Rémy, in southern France. He earned a doctor's degree in 1532, and became a professor at the University of Montpellier. The success of *Centuries* gained him an appointment as court physician to King Charles IX of France. He also became an adviser to Catherine de Médicis, wife of King Henry II of France.

The Cathedral of Notre Dame is a masterpiece of Gothic architecture and one of the most famous buildings in Europe. It stands on a small island in the Seine River in the heart of Paris. The cathedral was built between 1163 and 1250. This picture shows the main entrance.

Nostradamus's prophecies are vague and open to interpretation. One published in 1921 seemed to predict World War II (1939-1945). During that war, the Nazis issued their own versions of Nostradamus's prophecies to convince the German people and their European enemies of the Nazis' ultimate victory.

Nostril. See **Nose.**

Notary public is an officer authorized by law to certify certain documents, and to take oaths. Many documents, such as deeds, must be notarized before they become legally effective. The purpose of notarizing a document is to protect those who use it from forgeries. The notary signs the document to certify that the individual who signed it appeared in person and swore to the notary that the signature on the document is genuine. The notary records that fact, then stamps a seal on the document. The seal carries information about the name and location of the notary.

Notaries are usually allowed to charge for their services. In Great Britain and Canada, the Court of Faculties appoints notaries. In many states of the United States, any responsible person can get a commission as a notary public, on payment of a fee.

Notation is any system of symbols and abbreviations that helps people work with a particular subject. Mathematics uses notation to simplify and consolidate ideas and problems. The Arabic numeral system is a notational device for writing numbers and making arithmetic and other branches of mathematics easier. Chemistry, music, and other subjects have notation systems.

See also **Arabic numerals; Numeration systems; Music** (Musical notation); **Symbol.**

Note. See **Promissory note.**

Notornis is the scientific name for an extremely rare, flightless, New Zealand bird that is also called the *takahe.* It is now extinct in the North Island. This type of bird was widespread in the South Island in early times. Only a few specimens of the notornis were obtained from 1849 to 1898. It was then lost, and scientists thought it was extinct. It was rediscovered in 1948.

Notre Dame, Cathedral of, is a famous cathedral in Paris. It stands on the Île de la Cité, a small island in the Seine River, in the centre of Paris. The cathedral is dedicated to *Notre Dame,* the French expression for *Our Lady,* the Virgin Mary. The cathedral is one of the finest examples of Gothic architecture.

The cathedral stands on the site of two earlier churches. Construction of the present building occurred between 1163 and 1250. During the French Revolution in the late 1700's, Notre Dame was heavily damaged by mobs who regarded the church as a symbol of the hated monarchy. Beginning in 1845, the French architect Eugène Emmanuel Viollet-le-Duc directed extensive restorations of Notre Dame. He was responsible for much of the cathedral's present appearance.

Notre Dame was one of the first buildings to have *flying buttresses* (arched exterior supports). The buttresses permit the use of large stained glass windows that allow light to enter the building.

Nottingham is an industrial city in central England. It is the chief city in the district of Nottingham, which has a population of 261,500. Nottingham lies on the north bank of the River Trent. For the location of the city, see **England** (political map). The city is the administrative centre of the county of Nottinghamshire.

Nottingham's workers make bicycles, chemicals, hosiery and lace, and tobacco products. The district also has bleaching and dyeing, brewing, engineering, spinning, and tanning industries. The district includes Newstead Abbey, which was Lord Byron's home.

An old castle towers above the centre of Nottingham. Other major landmarks include the University of Nottingham and St. Mary's Church, a good example of English church architecture of the 1400's. Sherwood Forest, near Nottingham, was supposedly the home of the legendary English outlaw Robin Hood (see **Robin Hood**).

Nottingham existed by the 800's and became a major centre of the wool trade during the Middle Ages. During the late 1700's and early 1800's, the city prospered and its population increased rapidly as hosiery, knitting, and lacemaking industries developed there.

See also **Nottinghamshire.**

Nottinghamshire is a county in central England. It is famous for the legend of Robin Hood, who is supposed to have lived in Sherwood Forest with his band of outlaws. People know the county today for important industries that manufacture bicycles, clothing, tobacco, and drugs, for its rich coalfield, and for Nottingham lace.

Nottinghamshire was only slightly affected by the reorganization of England's local government in 1974. Two small parts of northern Nottinghamshire were taken into the new county of South Yorkshire. The city of Nottingham had been separately administered as a county borough. But in 1974 it became one of the local government districts in Nottinghamshire.

People and government

Local customs and legends. Nottinghamshire's most famous legendary hero is the outlaw Robin Hood. Nottingham's Goose Fair, held in October, has been an annual event for hundreds of years. Each February, Blidworth has its cradle-rocking ceremony, on the Sunday nearest to the Purification of the Virgin Mary. The last baby boy baptised in the parish is rocked in a cradle in front of the church altar. This commemorates the Holy Family's thanksgiving at the birth of Jesus Christ.

Recreation. The county has three soccer teams that play in the Football League: Mansfield Town, Nottingham Forest, and Notts County. The Nottinghamshire county cricket team plays in first-class cricket, and its ground, Trent Bridge, is used for some test matches. The United Kingdom's National Water Sports Centre at Holme Pierrepont, on the River Trent, hosts many international meetings. Other activities include fishing, horse racing, hunting, and pigeon fancying. Nottingham's Playhouse Theatre is the scene of the first performance of many plays before they move to London.

Facts in brief about Nottinghamshire

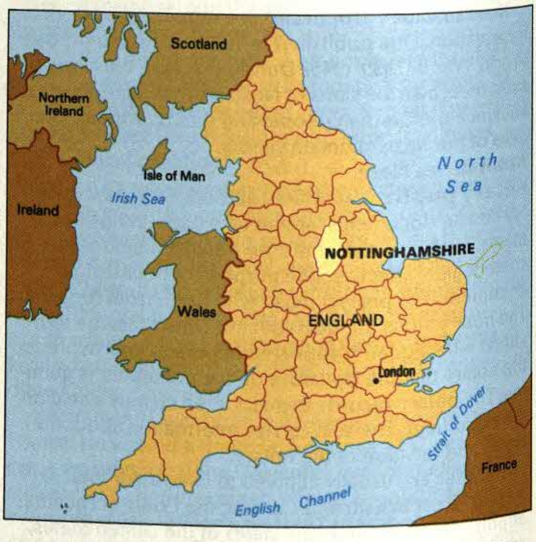
Administrative centre: Nottingham.
Largest towns: Nottingham, Beeston and Stapleford, Mansfield, Carlton, Sutton in Ashfield.
Area: 2,165 km².
Population: *1991 census*—980,600.
Chief products: *Agriculture*—barley, beef, dairy products, fruit, pigs, poultry, sugar beet, wheat. *Manufacturing*—beer, bicycles, bricks, cigarettes, clothing, drugs, engineering goods, food products, footwear, flour. *Mining*—coal, gypsum.

Local government. Nottinghamshire has eight local government districts: *Ashfield; Bassetlaw,* which includes all the northern part of the county; *Broxtowe,* which includes Eastwood; *Gedling,* which includes Arnold and Carlton; *Mansfield; Newark and Sherwood,* which includes all of eastern and central Nottinghamshire; *Nottingham;* and *Rushcliffe,* which covers the southeastern part of the county. The Nottinghamshire County Council, which has headquarters at Nottingham, provides some public services throughout the county.

The crown court sits at Nottingham. Nottinghamshire Constabulary, which polices the county, has its headquarters at Nottingham.

Economy

Manufacturing. Nottinghamshire has the largest bicycle factory in the world. It also has tobacco factories, founded by John Player in the 1870's. Drug-producing factories supply a nationwide chain of chemist shops founded by Sir Jesse Boot in the 1800's (see **Boot, Sir Jesse**). The lace industry has been associated with Nottinghamshire since the 1500's, but the manufacture of



Nottinghamshire is one of the five counties that together form the East Midlands region of central England.

Nottingham's city centre is dominated by its Council House. The bell of the clock can be heard 11 kilometres away.

hosiery, knitwear, and other garments has now developed into a more important industry.

Mansfield produces hosiery and other clothing, together with beer, bricks, engineering goods, footwear, and radar equipment. Newark is a market town with heavy engineering and agricultural engineering industries. Retford, another market town, has wire-rope making and constructional engineering industries.

Worksop is a coal-mining centre, but it also has a range of manufactures. These include food products and equipment for mining, quarrying, and railways. Worksop also has electrical, engineering, malting, and milling industries. In the Arnold area, industries include brewing, brick making, clothing manufacture, light engineering, and milling.

Agriculture. Farms cover nearly three-quarters of the county's land. Farmers in the east grow mainly barley and wheat. Some Nottinghamshire farmers also grow sugar beet. There are dairy farms in all parts of the county, but particularly in the Trent valley. Stilton cheese is an important dairy product. The Soar valley, in the southwest of the county, is an important area for fattening beef cattle. Farmers in this district also keep some sheep. The county has some pig and poultry farms. Smaller scale farming activities in Nottinghamshire include fruit growing and rose breeding. The Bramley Seedling apple was first grown in the 1860's near Southwell. Today it is one of the most popular varieties of cooking apple.

Mining and quarrying. The west of the county has a rich coalfield, which centres on Mansfield. Bevercotes Colliery, near Ollerton, opened in 1967 as one of the world's most modern coal mines. Nottinghamshire also produces gypsum.

Transport and communications. Nottinghamshire has a central position on Britain's rail and road systems. The M1 motorway, which runs from London to northern England, passes through the southwest of the county. The A1, the Great North Road, from London to Edinburgh, passes through the northeastern part of Nottinghamshire. The A46, running from Bath to Lincoln, passes through Newark. Railway lines link Nottingham with all parts of the country.

Nottingham has its own daily newspaper. It also has two local radio stations: one operated by the BBC, the

Places to visit

Following are brief descriptions of some of the interesting places to visit in Nottinghamshire:

Bothamsall Castle, near Worksop, is the earthwork of a Norman castle. From its top there is a good view of Sherwood Forest.

Clipstone, near Mansfield, has the ruins of King John's Palace, once a royal hunting lodge. Three kilometres away is Parliament Oak, where Edward I is supposed to have held his parliament in 1280.

Clumber Park, near Worksop, extends over 1,200 hectares. It has an attractive avenue of lime trees and splendid woodland walks.

Hawton, near Newark, has a church with an Easter sepulchre dating from the 1300's. The church has beautiful stone carvings.

Laxton is a village where strip farming is carried on as in Saxon days.

Littleborough, near Retford, has a tiny Norman church in which Roman tiles were used. A Roman ford lies in the local river.

Newark has a castle, dating from the 1170's, which played an important part in the Civil War. The town has many other historic buildings.

Newstead Abbey was founded in 1170 by King Henry II. It became the home of Lord Byron and now displays his bedroom and possessions.

Nottingham has a Norman castle which is now restored as a museum of art. An inn, the Trip to Jerusalem, is built into the castle rock. It is said to date from the 1100's. Woollaton Hall, an Elizabethan manor, now houses the city's natural history museum.

Sherwood Forest still has some of its former historic areas of trees. Its Major Oak is one of England's largest oaks.

Southwell Minster was built in the 1100's. It has beautiful stone carvings of plants and animals made in the 1200's.

other, Radio Trent, by an independent company under the IBA. Many towns have local weekly newspapers.

Land

Location and size. Nottinghamshire lies in the heart of England. It is one of five counties comprising the East Midlands region, on the eastern side of the industrial Midlands. Nottinghamshire is bounded by South Yorkshire and Humberside to the north, Lincolnshire to the east, Leicestershire to the south, and Derbyshire to the west. The county is roughly oval in shape. It extends 82 kilometres from north to south and 43 kilometres from east to west.

Land features. Nottinghamshire is on the eastern slopes of the Pennine chain. It has no mountains. Two-fifths of the land is less than 30 metres above sea level. The land rises to about 200 metres near the town of Mansfield in the west. It drops to as low as 1½ metres above sea level in the northeastern part of Nottinghamshire. The richest farmland lies in the southern, eastern, and northeastern parts of the county.

Near the Lincolnshire border in the east, the land forms a vast plain, which continues through Lincolnshire to the North Sea. Western Nottinghamshire is a rugged area, similar to the neighbouring county of Derbyshire. This area is rich in coal.

A wide sandstone strip extends from Nottingham in the southwest to Bawtry in the north. Most of the county's water supplies come from natural underground reservoirs in the sandstone.

The River Trent runs from north to south through the county. The River Soar borders the fertile farm lands in the southwestern part of Nottinghamshire. The River Leen was once important to Nottingham as the city's chief source of water.

Climate is similar to that of many eastern counties. Easterly winds, which blow in across the North Sea, cause occasional cold spells. January is the coldest month, with an average temperature of about 3° C. The warmest month is July, when the average is about 17° C. Rainfall averages 610 millimetres a year.

The young Robin Hood still bends his bow at Nottingham Castle in a bronze statue by the sculptor James Woodford.

Newark, a town on the River Trent in eastern Nottinghamshire, has one of the largest market squares in Britain.

History

People have lived in Nottinghamshire since Stone Age times. The county is named after an Anglian leader called Snot. His people invaded the area after the Romans left in the A.D. 400's. William the Conqueror made Nottingham a city and built a castle there in the 1000's. Charles I signalled the start of the Civil War from Nottinghamshire in 1642.

James Hargreaves and Richard Arkwright, important figures in the Industrial Revolution, both worked in Nottingham. Famous people born in the county include William Booth, who founded the Salvation Army, and the novelist D. H. Lawrence.

Nouakchott (pop. 350,000) is the capital and largest city of the West African republic of Mauritania. It lies in western Mauritania, along the Atlantic Ocean. For location, see **Mauritania** (map).

Government buildings and foreign embassies dominate the centre of the city. Nouakchott is overcrowded. The severe droughts that affected the Saharan region to the north during the 1970's forced large numbers of rural people to move to the city to obtain food and work. Many of them live in shacks and tents. Nouakchott has some modern housing, mostly centred on the Place de l'Indépendence (Independence Square). The city's products include hand-woven woollen carpets and other handicrafts, soft drinks, and chemical products. Nouakchott has an international airport and a seaport.

Nouakchott was founded in 1957, when France ruled Mauritania. It was established to replace St. Louis, Senegal, as the seat of Mauritania's colonial administration. It became the capital when Mauritania gained independence from France in 1960.

Nouméa. See **New Caledonia.**

Noun is a part of speech that identifies people, places, objects, actions, qualities, and ideas. The English language has a great variety of nouns. These nouns have been grouped into several classifications, some of which overlap.

Abstract and concrete nouns. Abstract nouns identify ideas and qualities that have no physical existence. *Bravery, effort,* and *knowledge* are abstract nouns. In contrast, concrete nouns identify objects that can be seen, heard, smelled, touched, or tasted. *Aeroplane, sponge cake,* and *skyscraper* are concrete nouns. Some words can be used as either abstract or concrete nouns. For example, *red* as an abstract noun may specify the quality of redness. As a concrete noun, it may represent the colour.

Abstract nouns usually function as mass nouns do. For example, an article may or may not be used with an abstract noun. It is correct to say either *He had courage* or *He had the courage.* However, an article must be used with a singular concrete noun—*He had a car,* not *He had car.*

Proper and common nouns. Proper nouns identify particular names or titles and are always capitalized. Examples include *Apollo II, Victoria Street, Green Park, New Year's Eve,* and *President Lincoln.* Proper nouns generally are used without an article, though it is correct to say *the United Kingdom* or *the River Ganges.*

All nouns that are not proper nouns are common nouns. They identify general categories of things. For example, *experiment, helper, holiday,* and *river* are all common nouns.

Collective nouns identify groups of persons, animals, or things. Examples include *audience, class, crowd, family, flock, government,* and *team.* A collective noun may be considered singular if the word is used as a unit. In this instance, the noun takes a singular verb. For example, *The cast of the play* was *at its best.* A collective noun is considered plural if the word is used in terms of its parts. The noun then takes a plural verb—*The cast* were applauded *loudly for their performances.*

Nominals are words and phrases that function as nouns. Pronouns are the most common nominals, but other parts of speech may be used as nouns:

Adjective: *The* strongest *was not best.*
Gerund: *Gardening is fun.*
Infinitive: To err *is human.*
Prepositions: *We knew the* ins *and* outs.
Pronoun: He *went for a walk.*

Number and case. English nouns may have endings that show *number* and *case.*

Number is the form which indicates that the noun refers to one (singular) or to more than one (plural). Singular nouns indicate one, such as *pear, apple, man,* and *mouse.* Plural forms for these nouns are *pears, apples, men,* and *mice.* Abstract nouns, and proper nouns do not ordinarily have distinct plural forms. But in special cases, these types of nouns may be used as concrete nouns—*There were three* Sams *in the room.*

Case is the form that helps show the relation of a noun to other words in a sentence. In some languages, words have many different endings to show relationships. In English, word order, rather than endings, shows relationships. Modern English nouns have only two cases, *common case* and *possessive case. Boy, man,* and *Sam* are common-case forms. *Boy's, man's,* and *Sam's* are possessive-case forms.

Gender. In English, nouns are sometimes said to have gender, but this feature is not usually shown by endings. An English noun has gender only in the sense that it is referred to by one of three pronouns: *he* or *him, she* or *her,* and *it. I found Jim and brought* him *home, I found Sally and brought* her *home,* or *I found a book and brought* it *home.*

Nouns for which the corresponding pronoun is *he* or *him* are *masculine* nouns. Nouns for which the corresponding pronoun is *she* or *her* are *feminine* nouns. Nouns for which the corresponding pronoun is *it* are *neuter* nouns. Usually, masculine nouns name males, feminine nouns name females, and neuter nouns name inanimate or sexless things. However, there are some exceptions. Some people think of a ship as feminine and refer to it as *she,* though most authorities prefer the neuter pronoun *it.* We may use such expressions as *There she goes!* in connection with almost any object. Such nouns as *baby, mosquito,* and *mouse* do not name sexless things, but we usually use neuter pronouns in connection with them. In many languages, the connection between sex and gender in grammar is not so close as it is in the English language.

Related articles in *World Book* include:

Case
Declension
Inflection
Number
Person
Sentence (Subject and predicate)

Nova is an explosion that causes a star to become from 10,000 to 100,000 times as bright as the sun. The star may shine this brightly for a month or longer before gradually fading to its original brightness. A nova hurls huge masses of gas and dust into space. The word *nova* comes from the Latin word for *new.* People once mistook novae for new stars.

Stars that undergo *fast novae* reach their maximum brightness several hours after the explosion. They begin to fade after a few days. Stars that undergo *slow novae* take much longer to reach their maximum brightness. However, they stay extremely bright for months or even years before they fade to their original brightness. Fast novae propel gas and dust outward at speeds of a few thousand kilometres per second. Slow novae do so about a tenth as fast.

Astronomers believe that novae occur in *close binaries.* A close binary is a double star system in which two stars revolve closely around each other (see **Binary star**). For a nova to occur, one of the stars must be medium-sized, and the other must be a small, extremely dense star called a *white dwarf.* The two stars are so close that the gravitational pull of the white dwarf draws material rich in hydrogen from the larger star. This material collects on the white dwarf and eventually triggers reactions of *nuclear fusion* there. In such reactions, hydrogen nuclei combine to form helium nuclei, and a large amount of energy is released. The reactions quickly become a runaway process, which results in a nova.

During the last 100 years, astronomers have observed some stars that have undergone more than one nova. Astronomers call such explosions *recurrent novae.* All novae may be recurrent, but for some of them the interval between explosions may be hundreds or even thousands of years. This much time may be required for a white dwarf to accumulate enough hydrogen for nuclear fusion to recur. On the other hand, the causes of recurrent and ordinary novae may differ, and ordinary novae may occur only once in a close binary.

Some close binaries undergo small explosions every month or so. These *dwarf novae* do not throw out material during an outburst, and they become only 10 to 100 times as bright as the sun. Their cause is unknown. Other stars undergo explosions called *supernovae,* which are thousands of times as bright as ordinary novae. Some supernovae occur in binaries, while other supernovae result from the collapse of extremely massive stars.

See also **Supernova.**

Nova Scotia (pop. 899,942) is one of the four Atlantic Provinces of Canada. It includes a peninsula of the Canadian mainland and also Cape Breton Island.

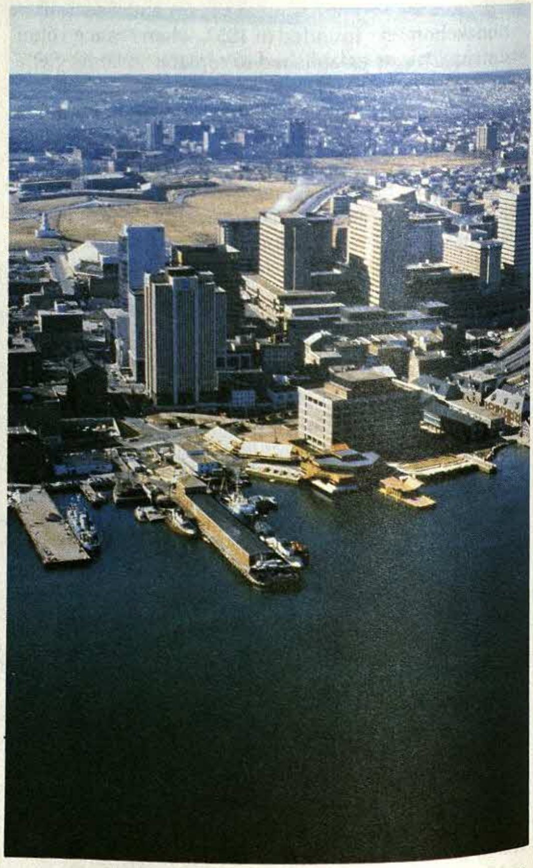
Service industries are the leading economic activity in Nova Scotia. These industries include education, government, and hotels and restaurants. Food processing is also important to the province's economy. Halifax is the capital of the province. See **Canada.**

Novalis (1772-1801) was the pen name of Friedrich von Hardenberg, a German romantic poet. Five poems by Novalis, called *Hymns to the Night* (1800), express his religious, mystical nature, and a longing for death. In the essay *Christianity or Europe* (1799), Novalis tried to show that people lived more meaningful lives in the spiritual unity of the Catholic Middle Ages than in his own time. This became a theme of German romanticism. He died before finishing a novel, *Heinrich von Ofterdingen.*

Novalis was born in Saxony. The death of his 15-year-old fiancée in 1797 deepened his melancholy and his religious temperament. Novalis' work as a mining engineer brought him close to the land and intensified his love of nature and its mysteries.

Novaya Zemlya is the Russian name for two islands in the Arctic Ocean that belong to Russia. The name means *new land.* The northern island is about 52,000 square kilometres in area. The southern island is about 38,800 square kilometres. The islands have a combined coastline of 2,736 kilometres. Novaya Zemlya has an arctic climate. The islands have large deposits of coal, and some gold and copper.

Russians first discovered Novaya Zemlya, probably in the A.D. 1000's. But the islands remained uninhabited until 1877, when they were annexed by Russia. The Soviet Union (which was formed in 1922 under the leadership of Russia, and existed until 1991) built villages for hunters. A small colony of Russians and Samoyeds live on the southern island. Islanders rear reindeer, trap animals, and collect *eider down* (the feathers of eider ducks). The Soviet Union tested nuclear bombs on the northern island, and Russia continues to use the island as a nuclear testing site.



Halifax, capital of Nova Scotia, is an important Canadian port city.

Novel is a long fictional story written in prose. It is one of the most popular forms of literature.

Novels can provide exciting stories and an escape from everyday life. However, they also appeal to people for many other reasons. Many novels encourage the reader to think about moral, social, or philosophical problems. Some novels point out injustices or evils that exist in society and challenge the reader to seek social or political reforms. Novels also may provide knowledge about unfamiliar subjects or give new insight into familiar ones.

The subject matter of novels covers the whole range of human experience and imagination. Some novels portray true-to-life characters and events. Writers of such *realistic novels* try to represent life as it is. One kind of realistic novel, the *psychological novel,* focuses on the thoughts and feelings of one or more characters in a story. In contrast to realistic novels, *romantic novels* portray idealized versions of life. Some novels explore purely imaginary worlds. For example, *science fiction novels* may describe events that take place in the future or on other planets. Other popular kinds of novels include detective novels and mysteries. The plots of such novels, which are full of suspense, fascinate countless readers.

As a literary form, the novel has four basic features that together distinguish it from other kinds of literature. First, a novel is a *narrative*—that is, a story presented by a teller. It thus differs from a drama, which presents a story through the speech and actions of characters.

Second, novels are longer than short stories, fairy tales, and most other types of narratives. Novels vary greatly in length, but most exceed 60,000 words. Because of their length, novels can cover a longer period of time and include more characters than can most other kinds of narratives.

Third, a novel is written in prose rather than verse. This feature distinguishes novels from long narrative poems.

Fourth, novels are works of fiction. They differ from histories, biographies, and other long prose narratives that tell about real events and people. Novelists sometimes base their stories on actual events or the lives of real persons. But these authors also make up incidents and characters. Therefore, all novels are partly, if not entirely, imaginary.

The basic features of the novel make it a uniquely flexible form of literature. Novelists can arrange incidents, describe places, and represent characters in an almost limitless variety of ways. They also may narrate their stories from different points of view. In some novels, for example, one of the characters tells the story. In others, the events may be described from the viewpoint of a person outside of the story. Some novelists change the point of view from one section of a story to another. Novelists also vary their treatment of time. They may devote hundreds of pages to the description of the events of a single day, or they may cover many years within about the same space.

Origins of the novel

This article discusses the development of the novel in Western literature. The novel became established as a literary form during the 1700's in England. However, its roots can be traced back to ancient Greek and Roman literature. Novels grew out of a narrative tradition in Europe that covered many centuries. They combined certain features of such nonfictional narratives as histories and biographies with those of fictional narratives. From histories and biographies, novelists learned to portray events and characters in realistic detail. At the same time, they drew upon the plots, themes, and techniques of early fictional narratives.

Ancient Greek and Roman narratives. In ancient times, most long narratives were composed in verse. Histories were among the few kinds of long narratives written in prose. The earliest known histories were written by two Greek authors, Herodotus and Thucydides, during the 400's B.C.

The finest fictional narratives of ancient Greece were long poems called *epics,* which told about the deeds of legendary heroes and mythical gods. The *Iliad* and the *Odyssey,* the two most famous epics, were probably written by Homer between 800 and 700 B.C.

The Greeks also wrote long fictional stories called *romances.* These tales described fantastic adventures in foreign countries or related the plights of young lovers. Some writers composed *pastoral romances,* which told of love between shepherds and maidens. One of the best-known Greek pastoral romances is *Daphnis and Chloe* (100's or 200's A.D.) by Longus.

The most important Roman narratives included *Satyricon* (about 60 A.D.) by Gaius Petronius and *Metamorphoses,* or *The Golden Ass* (mid-100's A.D.), by Lucius Apuleius. These earthy stories contrast sharply with the idealized love stories of the Greeks. *Satyricon* vividly portrays the adventures of three Roman scamps. *Metamorphoses* tells of a man who is changed into a donkey and travels through various countries observing the failings of human beings.

Later European narratives. Love and adventure stories called *romances of chivalry* became widely popular in Europe during the late Middle Ages. Many of the romances dealt with the legendary British King Arthur and his knights of the Round Table (see **Arthur, King; Round Table**).

During the 1500's and 1600's, many English romances were written in an extremely decorative style. After John Lyly of England wrote *Euphues: The Anatomy of Wit* (1578), this highly artificial style was called *euphuistic* and was widely imitated by other English writers.

In Spain, however, several narratives that were more realistic appeared during the 1500's. *La Celestina* (1499), by Fernando de Rojas, tells about a pair of young lovers brought together by the witchlike Celestina. One of the most influential narratives of the period was *Lazarillo de Tormes* (1554) by an unknown Spanish author. Some critics consider it the first *picaresque narrative.* It describes the struggles and adventures of a young *picaro* (rogue) who makes his way in the world through cunning and treachery. In some ways, the plot resembles that of the romances about knights. For example, it consists of a series of episodes in which the central character overcomes various obstacles and enemies. But in *Lazarillo de Tormes,* the rogue replaces the knight as the hero. And the city, with its social and economic strife, replaces the enchanted forests and magnificent castles of the romances of chivalry. The picaresque narrative described the classes of urban society and pictured city life of the 1500's.

The first novel, according to some critics, was the Spanish masterpiece *Don Quixote* (part I 1605; part II 1615) by Miguel de Cervantes. Other critics disagree, but almost all believe that *Don Quixote* contributed greatly to the development of the novel. Cervantes' story tells about a middle-aged landowner whose mind is filled with idealistic dreams from reading romances of chivalry. He imagines himself a knight and goes into the world to battle injustice. The central characters in *Don Quixote* differ significantly from the unbelievably heroic or clever characters in romances and picaresque narratives. Cervantes' characters resemble real people and often make foolish and tragic mistakes.

The rise of the English novel

The novel emerged as a distinct literary form during the 1700's in England. Authors deliberately tried to create belief in their stories. They described the lives of ordinary characters and dealt with the social and economic backgrounds of these people.

The first English novelists. Some critics regard Daniel Defoe as the first novelist, though his stories do not have unified plots. Defoe's *Robinson Crusoe* (1719) and *Moll Flanders* (1722) consist of a series of episodes in the lives of clever and resourceful, but ordinary, characters. *Robinson Crusoe* describes the adventures of a man marooned on an island for 24 years. *Moll Flanders* tells of a woman who becomes a thief and a prostitute but repents late in her life.

Samuel Richardson created novels with well-developed plots rather than disconnected episodes. His *Pamela; or Virtue Rewarded* (1740) tells of a virtuous female servant who resists her master's attempts to seduce her. The story is told in the form of letters, most of which are written by Pamela, the heroine, to her family. Through the letters, the reader follows Pamela's thoughts and feelings. Richardson thus reveals certain psychological aspects of the central character.

Henry Fielding wrote *The History of Tom Jones, a Foundling* (1749), which is especially noted for its elaborate, unified plot. This novel tells of the comical adventures of a young orphan. In *Joseph Andrews* (1742), Fielding described the behaviour of different classes of people. He emphasized how people's manners either disguise or reveal their true natures.

Tobias Smollett wrote amusing, loosely constructed novels about eccentric characters. Most critics consider *The Expedition of Humphry Clinker* (1771) to be Smollett's best novel. It is written in the form of letters. The novel reveals the personalities of a group of travellers as they meet people of various social classes.

Laurence Sterne was one of the greatest experimenters in the history of the novel. His masterpiece is *The Life and Opinions of Tristram Shandy, Gentleman* (1760-1767). *Tristram Shandy* is an unconventional novel of conversations and remembrances rather than action. The story humorously portrays a great variety of characters, philosophical ideas, and social customs.

Gothic novels became widely popular in England during the late 1700's and early 1800's. These horror stories tell of mysterious events that take place in gloomy, isolated castles. They have action-packed plots which are full of suspense. The best-known Gothic novels include *The Mysteries of Udolpho* (1794) by Ann Radcliffe and *Frankenstein* (1818) by Mary Shelley.

The 1800's

During the 1800's, English writers improved on the techniques of the early novelists and produced many great works. Authors in France, the United States, and Russia also wrote novels of major literary importance. The *romantic movement*, which stressed the need for full expression of human emotions and imagination, dominated the literature of the early 1800's. It was followed by the *realistic movement*, which demanded that literature accurately represent life as it is. See **Romanticism; Realism.**

Great Britain. Sir Walter Scott, a Scottish romantic writer, created and popularized *historical novels*. Such novels recreate the atmosphere of a past period and include actual characters and events from history. Scott wrote a long series of historical novels, including *Waverley* (1814) and *Ivanhoe* (1819).

The *novel of manners* appeared in England during the late 1700's. This type of novel details the customs of a particular social class. Social obligations are portrayed as strong influences on the characters. The novel of manners established the English tradition of writing about social relationships. Jane Austen was one of the greatest writers of novels of manners. Her *Pride and Prejudice* (1813) centres on the social conventions surrounding courtship and marriage.

Other major English novelists of the 1800's included William Makepeace Thackeray, Charles Dickens, George Eliot, and Thomas Hardy. Thackeray described the hypocrisy of upper-middle-class Londoners in his best-known novel, *Vanity Fair* (1847-1848). Dickens wrote about the social problems of the lower classes in England. His *Oliver Twist* (1837-1839) describes the difficulties of a young orphan growing up in an industrial city. Dickens portrayed the cruelty and greed of industrial society in *Hard Times* (1854). Eliot dealt chiefly with moral problems in her stories about English country people and small towns. Her novels include *Silas Marner* (1861) and *Middlemarch: A Study of Provincial Life* (1871-1872). Hardy wrote about pitiful characters who were fated to lead tragic lives in such novels as *Tess of the d'Urbervilles* (1891) and *Jude the Obscure* (1895).

France. French writers greatly influenced the development of the novel during the 1800's. Among the chief French novelists were Stendhal, Gustave Flaubert, and Émile Zola.

Stendhal contributed to the development of the psychological novel. His *The Red and the Black* (1830) is noted for its psychological portrait of the central character, Julien Sorel, a proud, ambitious man.

Flaubert wrote the famous novel *Madame Bovary* (1856), which tells about a woman who is unhappy in her marriage to a village doctor. She has a love affair to fulfil her dreams of romantic love and later kills herself. In the novel, Flaubert used factual details to create visual images that reveal the inner qualities of his characters. This technique influenced many other writers.

Zola helped establish *naturalism* as an important literary movement in the late 1800's. According to the theory of naturalism, much of a person's life is determined by heredity and environment. Naturalistic novels portray people who are trapped by circumstances beyond their control. Many of these novels deal with grim subjects. Zola's *Germinal* (1885), for example, describes the suffering of French miners.

The United States produced a number of major novelists during the 1800's. The most important ones included Nathaniel Hawthorne, Herman Melville, Mark Twain, and Henry James.

Hawthorne considered himself a writer of romances rather than of novels. In *The Scarlet Letter* (1850), he dramatized the tragic effects of wrongdoing and guilt on people. Hawthorne is noted for his use of symbolic settings and his insight into the darker side of human nature.

Melville wrote the masterpiece *Moby-Dick, or The Whale* (1851), which tells of a sea hunt for a fierce white whale. This novel deals symbolically with philosophical questions about good and evil.

Twain mastered an exaggerated, irreverent style of humour in his writings. He also was the first major American novelist to use *colloquial* (informal) speech in fiction. Twain's *The Adventures of Huckleberry Finn* (1884) tells about a young boy and a runaway slave who travel together down the Mississippi River on a raft. During their trip, the young boy Huck learns about the cruelty and hypocrisy of society.

James is acclaimed for his psychological portrayals of sensitive, intelligent characters and his mastery of the techniques of the novel. Although he was born in the United States, James is often considered an English novelist. He spent much of his life in England and followed the English tradition of writing about social relationships. James's novels include *The Portrait of a Lady* (1880-1881) and *The Ambassadors* (1903).

During the late 1800's and early 1900's, the French naturalistic movement influenced such American writers as Stephen Crane and Theodore Dreiser. Crane's first novel, *Maggie: A Girl of the Streets* (1893), pictures the cruelty and vulgarity of slum life. Dreiser's *Sister Carrie* (1900) tells of a poor, lonely young woman in Chicago. She lives for a time with a travelling salesman and then runs off to New York City with a wealthy married man. Later, the man kills himself and the young woman becomes a successful but unhappy actress.

Russia produced its two greatest novelists, Leo Tolstoy and Fyodor Dostoevsky, during the 1800's. Tolstoy and Dostoevsky rank as supreme masters of the realistic novel.

Tolstoy's famous masterpiece, *War and Peace* (1869), centres on the 1812 invasion of Russia by the French emperor Napoleon I. The account of the war is interwoven with stories about the lives of several Russian families. The many characters in *War and Peace* represent every level of Russian society. Tolstoy's other major novel, *Anna Karenina* (1875-1877), tells of a tragic love affair.

Dostoevsky won fame for his probing psychological insight and his treatment of philosophical ideas. In *Crime and Punishment* (1866), Dostoevsky explored the anguished mind of a young student who commits two murders. *The Brothers Karamazov* (1879-1880), Dostoevsky's greatest novel, deals with the relationships between a father and his four sons, one of whom kills the father.

The modern novel

Authors from almost every country have written great novels during the 1900's. Novelists have experimented with various styles, techniques, and types of plots. World War I (1914-1918) had a major impact on many writers. The noble ideals and high hopes with which nations entered the war were shattered by the length and destruction of the conflict. After the war, many novelists dealt with the social changes and personal disillusionments of modern times. After World War II (1939-1945), novelists continued to explore the problems of modern life.

New directions in the novel. Joseph Conrad, a Polish-born author who wrote in English, was a major writer of the early 1900's. In *Nostromo* (1904) and other novels, he portrayed the cruel and selfish side of human nature.

Marcel Proust of France wrote the masterpiece *Remembrance of Things Past* (1913-1927). This seven-part novel deals with many subjects and portrays French society in the process of change during the early 1900's. Proust used such experimental techniques as poetic daydreams and passages of elaborate dialogue to tell his story. Two later French novels, *The Counterfeiters* (1926) by André Gide and *Death on the Instalment Plan* (1936) by Louis-Ferdinand Céline, reflect experimental techniques somewhat like those of Proust.

The Irish writer James Joyce is considered one of the greatest novelists of the 1900's. He used a technique called *stream of consciousness,* in which the writer presents the thoughts, sensations, and memories that flow through the mind of a character. In *Ulysses* (1922), Joyce contrasted the central characters with the heroes of the *Odyssey,* the ancient Greek epic. *Ulysses* emphasizes the breakdown of personal values and the insignificance of human activities in modern times.

Virginia Woolf, an English author, also experimented with the stream-of-consciousness technique. Her novels are noted for their symbolism and poetic style. In *To The Lighthouse* (1927), Woolf portrayed the fragility of human relationships amid the collapse of social values.

The greatest American novelists of the 1900's include F. Scott Fitzgerald, Ernest Hemingway, and William Faulkner. In *The Great Gatsby* (1925), Fitzgerald pictured the false glamour and moral emptiness of wealthy, pleasure-seeking Americans of the 1920's, an era called the *jazz age.* Hemingway captured the personal letdown and sense of loss that many Americans felt after World War I in *The Sun Also Rises* (1926) and *A Farewell to Arms* (1929). Faulkner used the stream-of-consciousness technique in *The Sound and The Fury* (1929) and other novels. Many of Faulkner's novels deal with the decline of Southern aristocratic families and the breakdown of traditional standards of behaviour.

Franz Kafka, a Czech author who wrote in German, produced puzzling novels that have an atmosphere of fantasy and nightmare. In *The Trial* (1925), Kafka portrayed the frustration and despair of an ordinary man entangled in the workings of government bureaucracy. The German novelist Thomas Mann also wrote about the frustrations of modern life, but the main characters in his novels are sensitive, intellectually gifted people. Mann's major novels include *The Magic Mountain* (1924) and *Doctor Faustus* (1947).

Existentialism, a philosophic movement, greatly influenced French literature during the late 1930's and the 1940's. Existentialists view life as meaningless and chaotic. They emphasize that individuals must choose their own way to live and act, and then accept full responsibility for their actions. The rise of existentialism in France resulted in a number of existential novels, including *Nausea* (1938) by Jean-Paul Sartre and *The Stranger* (1942) by Albert Camus. Sartre and Camus focused chiefly on moral issues. They were less concerned with experimental techniques than were previous novelists.

After World War II. During the 1950's, an experimental form called the *nouveau roman* (new novel) appeared in France. The nouveau roman writers rejected traditional features of novels, such as organized plots and clear-cut types of characters. Instead, they wrote novels that focused on exact descriptions of objects and events. Their movement was called the *new wave.* The nouveau roman writers included Alain Robbe-Grillet and Michel Butor. *Jealousy* (1957) by Robbe-Grillet typifies the nouveau roman.

Perhaps the most influential novelist of the 1950's was Samuel Beckett, an Irish-born author who wrote in both French and English. Beckett was influenced by James Joyce and used the stream-of-consciousness technique in *Malone Dies* (1951). This novel centres on the repressed hysteria of a dying tramp named Malone.

In England, the leading post-war novelists included Graham Greene and William Golding. Greene dealt with religious and moral problems in *The Heart of the Matter* (1948). Golding also explored moral issues in *Lord of the Flies* (1954), which tells of a group of boys who are stranded on an island and begin to act like savages. Other post-war English novelists included Kingsley Amis, Anthony Burgess, Doris Lessing, Iris Murdoch, and Muriel Spark.

American writers produced fairly conventional novels during the 1950's. One of the most popular novels of this period was *The Catcher in the Rye* (1951) by J. D. Salinger. It tells about the problems of a dropout from school in New York City. The novels of Saul Bellow and Bernard Malamud deal partly with Jewish life in the United States. Bellow followed the form of the picaresque narrative in *The Adventures of Augie March* (1953). He later showed more experimental techniques in *Herzog* (1964), a novel about a college teacher. *Herzog* combines direct narration with the letters and thoughts of Moses Herzog, the central character. In *The Assistant* (1957), Malamud portrayed the relationship between a poor Jewish shopkeeper and his helper.

The American novelists Ralph Ellison and James Baldwin focused on the difficulties faced by blacks in the United States. Ellison's *Invisible Man* (1952) describes a young black man's growing awareness of his "invisibility." The youth feels a lack of identity in an impersonal society. Baldwin's *Go Tell It on the Mountain* (1953) tells of a poor black family in New York City.

The *black humour* style in fiction became popular during the 1960's. Black humorists treat serious subjects in a darkly comic manner. Their stories are both funny and tragic. For example, *Catch-22* (1961), by the American author Joseph Heller, deals humorously with the absurdities of warfare and military organizations, but also captures the terrifying confusion of war.

The novel today features several international trends that appeared during the 1960's and 1970's. One of the trends was introduced by a group of authors who wrote *nonfiction novels.* These novelists combined a documentary style with fictional techniques to tell about actual events and people.

Truman Capote, an American writer, originated the term "nonfiction novel" to describe his *In Cold Blood* (1966). Capote based this work on an actual 1959 murder case in which two men killed a farm family. He used documented facts about the case and wrote in a style typical of newspaper writing. The British writer Peter Ackroyd mingled historical fact with fiction in *Hawksmoor* (1985).

The novel today is an international literary form. Novelists writing in English included the Australian Patrick White, who wrote *Voss* (1957) and *The Eye of the Storm* (1973). White won the Nobel Prize for literature in 1973, and many critics consider him to be the first great novelist of Australian literature. A leading Indian novelist in English is Rasipuram Krishnaswami Narayan, who wrote *The Vendor of Sweets* (1967). Vidiadhar Surajprasad Naipaul is one of the finest novelists of the Caribbean. He wrote *A House for Mr Biswas* (1961) and *A Bend in the River* (1979). Modern South African novelists include writers in both English and Afrikaans. André Brink, a leading radical, wrote *Kennis van die Aand* (Looking on Darkness, 1974). One of Africa's best modern writers is the Nigerian novelist Chinua Achebe. His novels include *Things Fall Apart* (1958) and *Man of the People* (1966). Ireland has produced a number of fine modern novelists, including Flann O'Brien and Brian Moore.

Leading modern British novelists include Martin Amis, William Boyd, Anita Brookner, A.N. Wilson, and Julian Barnes. Another novelist who has received praise from critics is the Japanese-born Kazuo Ishiguro, who writes in English.

Among modern novelists writing in other languages are Carlos Fuentes of Mexico, Mario Vargas Llosa of Peru, and Jorge Luis Borges of Argentina (Spanish); Jorge Amado of Brazil (Portuguese); and Italo Calvino of Italy (Italian). A leading French novelist, and one of the world's foremost women writers, is Marguerite Duras, who wrote *The Lover* (1984).

Related articles. See the articles on the various national literatures, such as **American literature** and **French literature,** and their lists of *Related articles.* See also the following articles:

Detective story
Epic
Existentialism
Fiction
Gothic novel
Literature
Naturalism
Prose
Realism
Romance
Romanticism
Science fiction
Short story

Novello, Ivor (1893-1951), became well known as the composer of one of the most popular songs of World War I (1914-1918), *Keep the Home Fires Burning.* He was also an accomplished actor-manager, film actor, and dramatist. Novello appeared in many of the plays and musicals which he wrote and composed. These include *The Truth Game* (1928), *Careless Rapture* (1936), and *The Dancing Years* (1939).

Novello was born in Cardiff, Wales, and named David Ivor Davies.

November is the eleventh month of the year according to the Gregorian calendar, which is used in almost all the world today. It takes its name from *novem*, the Latin word for *nine*. In the early Roman calendar, November was the ninth month. Because July was named for Julius Caesar and August for Augustus Caesar, the Roman Senate offered to name the eleventh month for Tiberius Caesar. He refused modestly, saying, "What will you do if you have thirteen emperors?" Originally there were 30 days in November, then 29, then 31. From the time of Augustus, it has had 30 days.

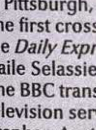
In the Northern Hemisphere, November comes between autumn and winter. In these temperate lands during November, the trees are bare, and the dead leaves on the earth have lost the brilliant colour they had in October. In Britain and elsewhere in northern Europe, the first snows of winter may fall. There may also be mist and fog. But the greys and browns of the November landscape are sometimes relieved by delightful days of hazy sunshine. The Anglo-Saxons referred to November as "the wind month" and sometimes "the blood month," probably because during this period they killed animals for their winter meat.

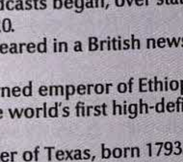
Activities. Many outdoor activities in the Northern Hemisphere come to a halt in November. The crops have been harvested and stored. Gardeners collect fallen leaves and tidy flowerbeds. In parts of the Southern Hemisphere, late November marks the start of the wet season.

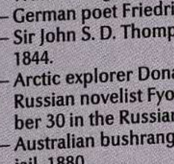
Special days. Scots around the world know that Nov. 30 is St. Andrew's Day. St. Andrew is the patron saint of Scotland. Near the end of November, the people of the

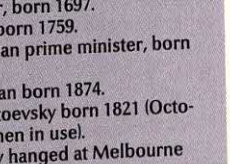
Important November events

- **1** Benvenuto Cellini, Italian goldsmith, born 1500.
  - Crawford W. Long, physician who first used ether as an anaesthetic in surgery, born 1815.
- **2** Edward V, king of England, born 1470.
  - Daniel Boone, American frontiersman, born 1734.
  - Marie Antoinette, French queen, born 1755.
  - A Spanish expedition led by Gaspar de Portolá reached San Francisco Bay, on west coast of U.S.A., 1769.
  - James K. Polk, U.S. president, born 1795.
  - Warren G. Harding, U.S. president born 1865.
  - Luchino de Visconti, Italian film director, born 1906.
  - Arthur Balfour, British foreign secretary, proposed settlement of Jewish people in Palestine, 1917.
  - First regular radio broadcasts began, over station KDKA in Pittsburgh, U.S.A., 1920.
  - The first crossword appeared in a British newspaper, the *Daily Express,* 1924.
  - Haile Selassie was crowned emperor of Ethiopia, 1930.
  - The BBC transmitted the world's first high-definition television service, 1936.
- **3** Stephen Austin, colonizer of Texas, born 1793.
  - Canadian explorer Vilhjalmur Stefansson born 1879.
- **4** Erie Canal formally opened at New York, U.S.A., 1825.
  - Iranian revolutionaries took over the U.S. Embassy in Teheran and seized U.S. citizens as hostages, 1979.
- **5** Guy Fawkes Day, commemorating the failure of the Gunpowder Plot to blow up the English Houses of Parliament, 1605.
- **6** John Philip Sousa, American bandmaster, born 1854.
  - Ignace Jan Paderewski, Polish pianist, composer, and statesman, born 1860.
- **7** Marie Curie, Polish-born physicist, born 1867.
  - Last spike driven in Canadian Pacific Railway (now CP Rail), 1885.
  - French author Albert Camus born 1913.
  - Bolsheviks ousted provisional Russian government, 1917. The date was October 25 in the Russian calendar then in use.
  - Joan Sutherland, Australian opera singer, born 1926.
  - Charles Kingsford Smith, Australian aviator, disappeared after leaving Allahabad, India on a long-distance flight 1935.
- **8** Edmond Halley, British astronomer, born 1656.
- **9** Ivan Turgenev, Russian novelist, born 1818.
  - Edward VII, king of the United Kingdom, born 1841.
  - Kaiser Wilhelm II abdicated German throne, 1918.
- **10** Martin Luther, German religious leader and one of the founders of Protestantism, born 1483.
  - William Hogarth, English painter, born 1697.
  - German poet Friedrich Schiller born 1759.
  - Sir John S. D. Thompson, Canadian prime minister, born 1844.
  - Arctic explorer Donald MacMillan born 1874.
- **11** Russian novelist Fyodor M. Dostoevsky born 1821 (October 30 in the Russian calendar then in use).
  - Australian bushranger Ned Kelly hanged at Melbourne jail, 1880.
  - Armistice signed ending World War I, 1918. The day is marked by remembrance ceremonies in many countries, in tribute to those who died in both World War I and World War II, and other wars.
  - Opening of the Berlin Wall, 1989.
- **12** Auguste Rodin, French sculptor, born 1840.
  - Ross and Keith Smith took off from England to make the first flight to Australia, 1919.
- **13** Edward III, king of England, born 1312.
  - Battle of Preston, when English government troops defeated rebels supporting the Jacobite cause, 1715.
  - Sir John Moore, British soldier, born 1761.
  - James Clerk Maxwell, Scottish physicist, born 1831.
  - Scottish novelist, essayist and poet Robert Louis Stevenson born 1850.


Nov. birthstone topaz


Nov. 5—Guy Fawkes Day


Nov. 7—Marie Curie born


Nov. 12—Start of first England-Australia flight

United States celebrate Thanksgiving Day. November 30 is National Heroes' Day in the Philippines. Children in England enjoy fireworks and bonfire parties on Guy Fawkes night, on Nov. 5. November 11, Armistice Day, marks the end of the fighting in World War 1 (1914-1918), and in many countries there are Remembrance Day parades and religious services to honour the dead of both World War I and World War II (1939-1945).

November symbols. The topaz is the November birthstone, and the special flower of the month is the chrysanthemum.

Quotations

November's sky is chill and drear,
November's leaf is red and sear.
Sir Walter Scott

Autumn wins you best by this, its mute
Appeal to sympathy for its decay.
Robert Browning

The wild November comes at last
Beneath a veil of rain;
The night wind blows its folds aside,
Her face is full of pain.
Richard Henry Stoddard

November woods are bare and still;
November days are clear and bright;
Each noon burns up the morning's chill,
The morning's snow is gone by night.
Helen Hunt Jackson

See also **Calendar; Chrysanthemum; Thanksgiving Day; Topaz.**

Important November events

— First telegraph service between London and Paris began, 1951.
— Eugene Ionesco, Romanian playwright, born 1912.
— Ahmed Sukarno became president of Indonesia, 1945.
— End of the so-called 'cod war' between UK and Iceland, 1973.
14 Robert Fulton, American inventor, born 1765.
— Claude Monet, French painter, born 1840.
— Indian leader Jawaharlal Nehru, the nation's first prime minister after independence, born 1889.
— Canadian physician Frederick Grant Banting, famous for discovering insulin, born 1891.
— Aaron Copland, American composer, born 1900.
— Prince Charles, Prince of Wales and heir to British throne, born 1948.
15 William Pitt the Elder, (the Earl of Chatham), British prime minister, born 1708.
— William Herschel, English astronomer, born 1738.
— First meeting of League of Nations Assembly, 1920.
— Manuel Quezon inaugurated as first president of the Philippines, 1935.
16 Canadian poet Louis H. Fréchette born 1839.
— German composer Paul Hindemith born 1895.
17 Suez Canal opened, 1869.
18 Louis Jacques Daguerre, French painter and inventor of the daguerreotype, born 1787.
— Sir William S. Gilbert, English dramatist who worked with composer Sir Arthur Sullivan, born 1836.
— United States and Panama signed treaty providing for Panama Canal, 1903.
— Eugene Ormandy, American conductor, born 1899.
19 Explorer of the American West George Rogers Clark born 1752.
— Ferdinand de Lesseps, French promoter of Suez Canal, born 1805.
— U.S. President Abraham Lincoln delivered Gettysburg Address, 1863.
19 Indira Gandhi, first woman prime minister of India, born 1917.
20 Sir Wilfrid Laurier, Canadian statesman, born 1841.
— Selma Lagerlöf, Swedish novelist, born 1858.
21 Voltaire, French author and philosopher, born 1694.
22 French explorer Sieur de La Salle born 1643.
— George Eliot, English novelist, born 1819.
— Charles de Gaulle, French statesman, born 1890.
— Benjamin Britten, British composer, born 1913.
— First transpacific air-mail flight began, 1935.
— U.S. President John F. Kennedy assassinated, 1963.
23 Radio broadcasting began in Australia, 1923.
24 Baruch Spinoza, Dutch philosopher, born 1632.
— Franciscan missionary Father Junípero Serra born 1713.
— Laurence Sterne, British novelist, born 1713.
— *On the Origin of Species,* by Charles Darwin, published 1859.
— French painter Henri de Toulouse-Lautrec born 1864.
25 Lope de Vega, Spanish playwright, born 1562.
— John Flynn, founder of the Royal Flying Doctor Service, born in Victoria, Australia, 1880.
— Pope John XXIII born 1881.
26 First national Thanksgiving Day in United States proclaimed by President George Washington, 1789.
— The name Van Diemen's Land was officially replaced by Tasmania, 1855.
27 Charles A. Beard, American historian, born 1874.
28 William Blake, English poet and artist, born 1757.
— Stefan Zweig, Austrian biographer, born 1881.
29 Louisa M. Alcott, American author, born 1832.
— American explorer Commander Richard E. Byrd and crew of three became first to fly over South Pole, 1929.
30 English author Jonathan Swift, who wrote *Gulliver's Travels,* born 1667.
— Mark Twain, American author, born 1835.
— British statesman Sir Winston Churchill born 1874.

Nov. 19—Indira Gandhi born

Nov. 22—Charles de Gaulle born

Nov. 22—John F. Kennedy killed

Nov. 30—Winston Churchill born

Novgorod (pop. 232,000) is an important industrial centre and one of the oldest cities in Russia. It lies on both banks of the Volkhov River. For location, see **Russia** (political map). Novgorod has numerous architectural monuments built between the 1000's and 1600's, including many churches. These sites attract many tourists. Novgorod's industries include the production of chemicals, china, furniture, and machinery.

Novgorod probably existed as early as the A.D. 600's. In the 900's, it became an important city in Kievan Rus—the first East Slavic state. Between the 1200's and 1500's, the city was a major financial and commercial centre. In the early 1600's, Swedish forces invaded the area. They caused much destruction in Novgorod. After the Russian Revolution of 1917, the government established factories in Novgorod. German forces destroyed much of Novgorod during World War II (1939-1945). After the war, the city was rebuilt as an industrial centre and historic landmarks were restored.

Novi Sad (pop. 213,860) is a Serbian centre of manufacturing and transportation. The city lies about 70 kilometres northwest of Belgrade. For the location of Novi Sad, see **Serbia** (map).

The Danube River and the Mali Bački Canal meet at Novi Sad. The canal forms part of a system of waterways that links the Danube and Tisa rivers. Novi Sad also lies on the main road and railway between Belgrade and Budapest, Hungary. The city produces electrochemical equipment and processed foods.

Novi Sad was founded in the early 1690's as the headquarters of the Serbian Orthodox Church. It grew as a trade centre for the nearby farm area. A boom began in Novi Sad during the 1960's after petroleum and natural gas were found near the city.

Novocain. See **Procaine.**

Novosibirsk (pop. 1,443,000) is an important centre of manufacturing in Russia. The city lies on the Ob River, about 2,740 kilometres east of Moscow, in Siberia. Novosibirsk is the largest city in Siberia. For the location of Novosibirsk, see **Russia** (political map).

Many factories in Novosibirsk manufacture heavy equipment, including farm and mining machinery and diesel trucks. The city also produces steel. Airlines, railways, and riverboats serve Novosibirsk.

Novosibirsk was founded in 1893 as a settlement for workers building a railway across Siberia. The city grew as a transportation centre. Manufacturing boomed during World War II (1939-1945), when the government moved many factories from combat areas to the safety of Novosibirsk. In 1958, the government built Akademgorodok, a suburb of Novosibirsk, as a centre of research in chemistry, physics, and other sciences.

Noyes, Alfred (1880-1958), was one of the most popular English poets of the early 1900's. He became famous for his ballads and lyric poems about English history. His reputation has declined since the mid-1900's, but some of his poetry remains popular with children, especially the exciting ballad "The Highwayman" (1906).

Noyes was born in Wolverhampton. His most ambitious work was perhaps *The Torchbearers,* a long three-part poem. It honours the contributions of the great scientists of history. The poem consists of *The Watchers of the Sky* (1922), *The Book of Earth* (1925), and *The Last Voyage* (1930).

Noyes also wrote literary criticism, novels, plays, and short stories. Some of his literary essays were collected in *Pageant of Letters* (1940). Noyes also wrote an autobiography, *Two Worlds from Memory* (1953).

NSPCC is a British organization that helps children and parents with problems affecting the family. It is officially called the National Society for the Prevention of Cruelty to Children. The society is *voluntary* (financed only by donations and fund-raising activities). It runs about 65 teams of child protection specialists in England, Wales, and Northern Ireland. The ISPCC (Irish Society) operates in the Republic of Ireland and the RSSPCC (Royal Scottish Society) in Scotland. Both societies, like the NSPCC, are voluntary. They employ professionally trained staff social workers and playgroup staff. Churches, health boards, trade unions, and similar groups help to support the societies.

Some of the NSPCC's work is done by visiting children and parents in their own homes, trying to prevent the break-up of the family. In many cases, parents ask the society for help and advice. The society also investigates child neglect and ill-treatment.

The society was founded in 1884. The founders included the Earl of Shaftesbury and Thomas Barnardo, founder of Dr. Barnardo's Homes (see **Barnardo, Thomas John**). The society took its present name in 1889, the year the British Parliament passed the first act to protect children from neglect or ill-treatment.

Nu, U (1907-   ), is a Burmese politician and statesman. In the 1930's, he was a leader of a student political movement against British colonial rule. In 1948, he became the first prime minister of independent Burma. He left his post for eight months during 1956 and 1957 to reorganize the Anti-Fascist People's Freedom League, the country's most important political party. After a split in the ruling party, he resigned in 1958. He was named prime minister again in 1960, but was forced out of office in 1962 and placed under detention. He was released in 1966. U Nu left Burma in 1969 and led a revolt against the government from abroad. He returned to Burma in 1980. U Nu was born in Wakema, in the Myaungmya District of Burma. *U* is an honorary title similar to *mister.*

See also **Burma** (History).

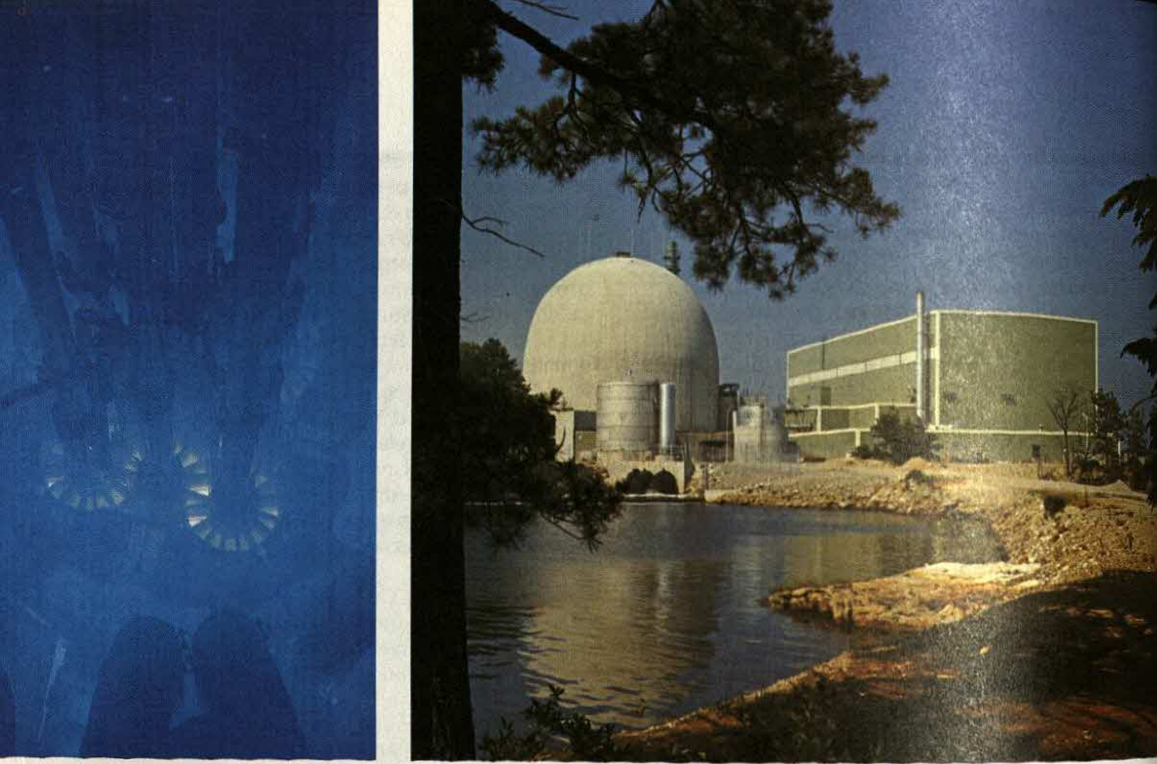
Nubia was a region of ancient Africa. It covered part of what is now Sudan. Nubia extended along the Nile River from the southern boundary of ancient Egypt almost to present-day Khartoum, Sudan.

The earliest Nubians were probably blacks. The Nubians were controlled by Egyptian rulers at times from about 2000 to 1000 B.C. The Egyptians regarded Nubia as a source of gold and as a trading centre for cattle, ivory, and slaves from central Africa.

Kush, the most important civilization of Nubia, developed rapidly after 1000 B.C. This Nubian kingdom, which lasted until about A.D. 350, became a centre of ironworking, learning, and trade. Kushites ruled Egypt from about 750 to 670 B.C. See **Kush.**

During the A.D. 500's, the people of Nubia were converted to Christianity. A large part of Nubia remained Christian until the 1300's, when Arab invaders conquered the region. They firmly established Islam, the religion of the Muslims.

Nuclear bomb. See **Nuclear weapon.**



The tremendous heat of nuclear energy is created deep within a *nuclear reactor, left,* a device that produces and controls nuclear energy. Water in the reactor keeps the device from melting. A nuclear power plant, *right,* uses the heat from a reactor to produce electricity.

Nuclear energy

Nuclear energy, also called *atomic energy,* is the most powerful kind of energy known. It produces the tremendous heat and light of the sun and the shattering blast of nuclear weapons. Nuclear energy results from changes in the *nucleus* (core) of atoms. Scientists and engineers have found many uses for this energy, especially in producing electricity. But they do not yet have the ability to make full use of nuclear power. If nuclear energy were fully developed, it could supply all the world's electricity for millions of years.

Scientists knew nothing about nuclear energy until the early 1900's. They then began to make important discoveries about matter and energy. They already knew that all matter consists of atoms. But scientists further learned that a nucleus makes up most of the mass of every atom and that this nucleus is held together by an extremely powerful force. A huge amount of energy is concentrated in the nucleus because of this force. The next step was to make nuclei let go of that energy.

Scientists first released nuclear energy on a large scale at the University of Chicago in 1942, three years after World War II began. This achievement led to the development of the atomic bomb. The first atomic bomb was exploded in the desert near Alamogordo, New Mexico, in the United States on July 16, 1945. Temperatures at the centre of the blast about equalled those at the sun's centre. In August, U.S. planes dropped atomic bombs on Hiroshima and Nagasaki, two cities in Japan. The bombs largely destroyed both cities and helped to bring about the end of World War II a month later. In 1949, the Soviet Union became the second nation to explode an atomic bomb. Today, at least six nations have nuclear bombs.

Since 1945, peaceful uses of nuclear energy have been developed. The energy released by nuclei creates large amounts of heat. This heat can be used to make steam, and the steam can be used to generate electricity. Engineers have invented devices called *nuclear reactors* to produce and control nuclear energy.

A nuclear reactor operates somewhat like a furnace. But instead of using such fuels as coal or oil, almost all reactors use uranium. And instead of burning in the reactor, the uranium *fissions*—that is, its nuclei split in two, releasing energy largely in the form of heat. The fission of 0.45 kilogram of uranium releases as much energy as the burning of 1,000 metric tons of coal.

Electric power production is by far the most important peaceful use of nuclear energy. In some countries, such as France, Belgium and Sweden, more than half of the total energy production relies on nuclear energy. Nuclear energy also powers some submarines and other ships. These vessels have a reactor to create heat for making the steam that turns the ship propellers. In addition, the fission that produces nuclear energy is valuable because it releases particles and rays called *nuclear radiation* that have uses in medicine, industry, and science. However, nuclear radiation can be extremely dangerous. Exposure to damaging amounts of radiation can result in a condition called *radiation sickness* (see **Radiation sickness**).

This article deals mainly with nuclear energy as a source of electricity. To learn about other uses of nuclear energy, see **Nuclear weapon; Radioactivity** (Uses of radioisotopes); **Ship** (Nuclear power and automation); **Submarine.**

Almost all the world's electricity is produced by *thermal* and *hydroelectric* power plants. Thermal plants use the force of steam from boiling water to generate electricity. Hydroelectric plants use the force of rushing water from a dam or waterfall. The great majority of thermal plants burn *fossil fuels,* chiefly coal and oil, to produce the heat needed to boil water. Fossil fuels developed from the remains of plants and animals that died many millions of years ago. The remaining thermal plants fission uranium to create heat.

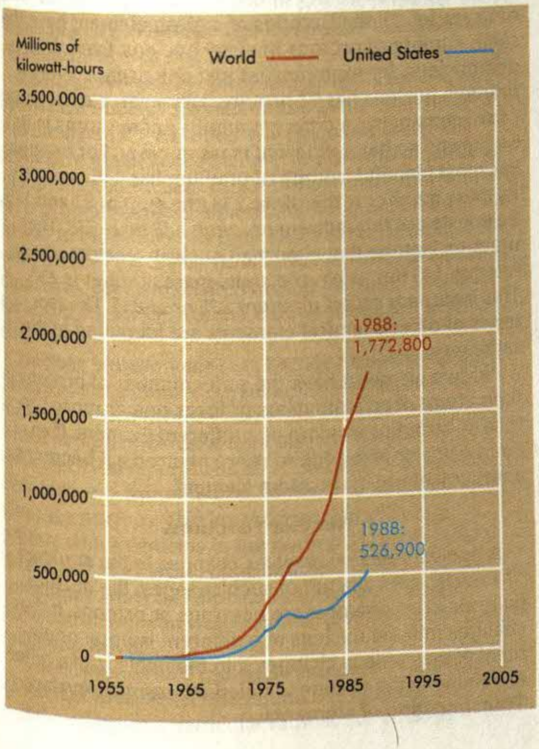
Hydroelectric plants cost much less to operate than do fossil-fuel plants. They are also cleaner than fossil-fuel plants, which produce much air pollution. But few countries have enough natural water power to generate large amounts of hydroelectricity. Most countries therefore depend mainly on fossil-fuel plants for their electric power.

The earth has only a limited supply of fossil fuels. Yet the worldwide demand for electricity increases every year. Nuclear plants may thus become more and more important. But today, they produce only about 16 per cent of the world's electricity.

Worldwide distribution of nuclear energy. In the late 1980's, about 420 nuclear power reactors operated in 26 countries. Six other countries plan to construct at least one reactor. Most nations, however, cannot afford the expensive equipment that a nuclear power plant requires.

Growth of nuclear power production

Nuclear power production has grown rapidly since the first full-scale nuclear power plant began operations in England in 1956.



The United States had about 110 nuclear power reactors operating in the late 1980's and was the world's chief producer of nuclear power. Nuclear reactors generate about 18 per cent of the country's electricity. Other major producers include Canada, France, Germany, Great Britain, Japan, Russia, and Sweden. Canada has 18 nuclear reactors, which produce about 15 per cent of the country's electricity. The United States and other leading producers have helped developing countries such as India and Pakistan to build their own nuclear power plants.

Advantages and disadvantages of nuclear energy. Nuclear power plants have two main advantages over fossil-fuel plants. (1) A nuclear plant uses much less fuel than does a fossil-fuel plant. The fissioning of 1 metric ton of uranium fuel, for example, provides about as much heat energy as the burning of 3 million metric tons of coal or 12 million barrels of oil. (2) Uranium, unlike fossil fuels, does not release chemical or solid pollutants into the air during use.

In spite of its advantages, nuclear energy has three main disadvantages that have slowed the development of nuclear power worldwide. (1) Nuclear plants cost more to build than fossil-fuel plants. (2) Nuclear plants are potentially hazardous. To make them as safe as possible, they must meet certain government regulations that fossil-fuel plants do not have to meet. For example, a nuclear plant must satisfy government authorities that it can quickly and automatically deal with any kind of emergency. In addition, many are opposing the construction of new plants since the 1979 accident at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania, and more recently, the 1986 accident at Chernobyl, in the Soviet Union. (3) Uranium continues to produce dangerous radiation long after it has been used up as a fuel for nuclear energy. The problem of safely storing uranium wastes has not yet been solved.

The full development of nuclear energy. Many experts believe that the benefits of nuclear power outweigh any problems involved in its production. These experts point out that the world's supply of oil may be nearly exhausted by the mid-2000's. China, Russia, the United States, and a number of other countries have enough coal to meet their energy requirements for hundreds of years. However, coal is an exceptionally dirty fuel that releases large amounts of sulphur and other pollutants into the air when it is burned (see **Environmental pollution**). If nuclear energy were fully developed, it could completely replace oil and coal as a source of electric power.

But a number of problems must be solved before nuclear energy can be fully developed. For example, almost all the power reactors used today require a type of uranium known as *U-235.* The world's supply of U-235 is limited. If U-235 continues to be used at the present rate, it will become increasingly scarce and will eventually be used up. Therefore, nuclear power cannot permanently replace other power sources until scientists develop a method of producing nuclear energy that does not require U-235. The subsection *Nuclear energy today* discusses the main methods of nuclear energy production under development.

The science of nuclear energy

The process by which a nucleus releases energy is called a *nuclear reaction.* To understand the various types of nuclear reactions, a person must know something about the nature of matter.

The composition of matter

All matter is made up of *chemical elements,* which are in turn composed of atoms. A chemical element consists of a substance that cannot be broken down chemically into simpler substances. There are 109 known chemical elements. Ninety-three of them are found in nature. The other 16 are artificially created. Scientists rank the elements according to *mass,* or weight. Hydrogen is the lightest natural element, and uranium the heaviest. Most of the artificially created elements are heavier than uranium.

Atoms and nuclei. An atom consists of a positively charged nucleus and one or more negative electric charges called *electrons.* The nucleus makes up almost all of an atom's mass. The electrons, which are almost massless, revolve about the nucleus. They determine the various chemical combinations that an atom enters into with other kinds of atoms (see **Chemistry** [Fundamental ideas of chemistry]). Electrons do not play an active part in nuclear reactions.

The nuclei of every chemical element except hydrogen consist of particles called *protons* and *neutrons.* An ordinary nucleus of hydrogen, the lightest element, has one proton and no neutrons. The heaviest elements, such as uranium and thorium, have the largest number of protons and neutrons in their nuclei.

Nuclear energy terms

Chain reaction is a continuous, self-sustaining series of fission reactions in a mass of uranium or plutonium.

Fission is the type of nuclear reaction that is used to release energy in nuclear reactors. It occurs when a nucleus of uranium or another heavy element is split into two nearly equal parts.

Fusion is a type of nuclear reaction that occurs when two lightweight nuclei *fuse* (combine) and form a heavier nucleus. Fusion produces the sun's energy.

Half-life is the time required for half the atoms of a radioactive substance to decay into another substance.

Isotopes are different forms of the same element. Their atoms, which are also called isotopes, have different mass numbers.

Mass number is the total number of neutrons and protons in the nucleus of an atom.

Neutron is an electrically *neutral* (uncharged) particle in a nucleus.

Nuclear radiation consists of high-energy particles and rays given off during a nuclear reaction.

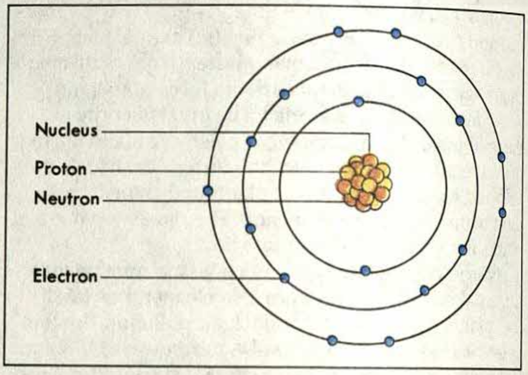
Nuclear reaction involves a change in the structure of a nucleus. Fission, fusion, and radioactive decay are the most important types of nuclear reactions.

Nuclear reactor is a device for producing nuclear energy by means of controlled chain reactions.

Nucleus is the core of an atom and carries a positive charge. The nuclei of all elements except hydrogen consist of neutrons and protons. An ordinary hydrogen nucleus has one proton and no neutrons.

Proton is a positively charged particle in a nucleus.

Radioactive decay, or radioactivity, is the process by which a nucleus *spontaneously* (naturally) changes into the nucleus of another isotope or element. The process releases energy mainly in the form of nuclear radiation.



An atom consists of a nucleus and one or more electrons. The nucleus, which makes up almost all of an atom's *mass,* or weight, consists of tiny particles called *protons* and *neutrons.* They are held together by an extremely powerful force.

Protons carry a positive charge. Neutrons carry no electric charge. Extremely strong forces, called *nuclear forces,* hold the protons and neutrons together in the nucleus. The nuclear forces of each type of nucleus determine the amount of energy that would be required to release its neutrons and protons. This energy is known as *binding energy.*

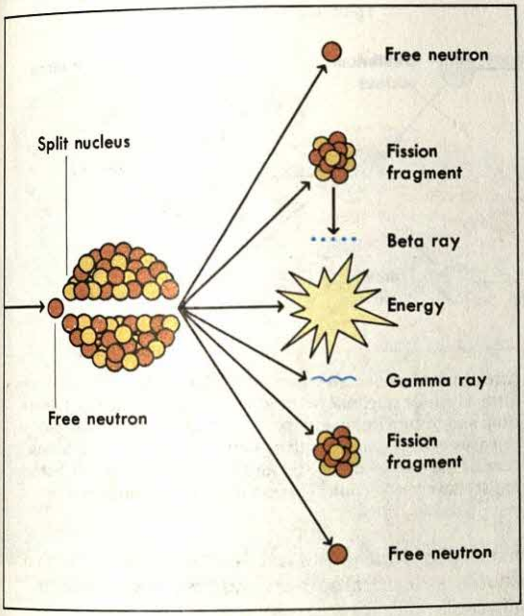
Isotopes. Most chemical elements have more than one form. These different forms are called the *isotopes* of an element. The atoms that make up each of the different forms have different weights and are also called isotopes.

Scientists identify an isotope by its *mass number*—that is, the total number of protons and neutrons in each of its nuclei. All the isotopes of a given element have the same number of protons in every nucleus. Every hydrogen nucleus, for example, has just one proton. Every uranium nucleus has 92 protons. However, each isotope of an element has a different number of neutrons in its nuclei and so has a different mass number. For example, the most plentiful isotope of uranium has 146 neutrons. Its mass number is therefore 238 (the sum of 92 and 146). Scientists call this isotope *uranium 238* or *U-238.* The uranium isotope that almost all nuclear reactors use as fuel has 143 neutrons, and so its mass number is 235. This isotope is called *uranium 235* or *U-235.* The isotopes of other chemical elements are identified in the same way.

No two elements have the same number of protons in their atoms. If an atom gains or loses one or more protons, it becomes an atom of a different element. If an atom gains or loses one or more neutrons, it becomes another isotope of the same element.

Nuclear reactions

A nuclear reaction involves changes in the structure of a nucleus. As a result of such changes, the nucleus gains or loses one or more neutrons or protons. It thus changes into the nucleus of a different isotope or element. If the nucleus changes into the nucleus of a different element, the change is called a *transmutation* (see **Transmutation of elements**).



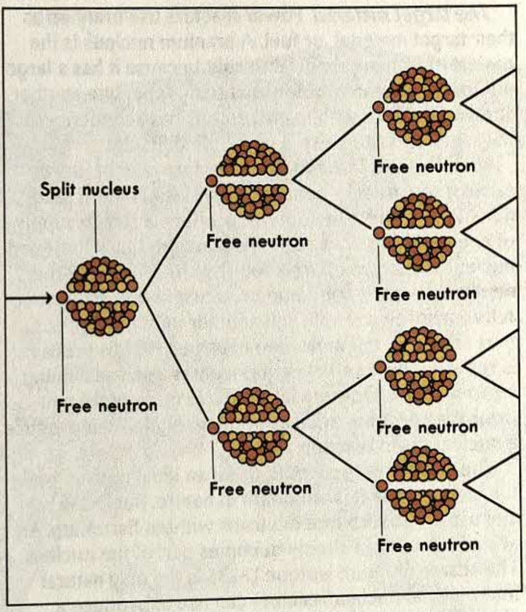
Nuclear fission is the chief method of producing nuclear energy. It involves using a free neutron to split a nucleus of a heavy element, such as uranium, into two *fission fragments.* Besides heat energy, fission releases neutrons and such nuclear radiation as gamma rays. The fragments give off beta rays.

Three types of nuclear reactions release useful amounts of energy. These reactions are (1) radioactive decay, (2) nuclear fission, and (3) nuclear fusion. The matter involved in each reaction weighs less after the reaction than it did before. The lost matter has changed into energy.

Radioactive decay, or radioactivity, is the process by which a nucleus *spontaneously* (naturally) changes into the nucleus of another isotope or element. The process releases energy chiefly in the form of particles and rays called nuclear radiation. Uranium, thorium, and several other natural elements decay spontaneously and so add to the natural, or *background,* radiation that is always present on the earth. Nuclear reactors produce radioactive decay artificially. Nuclear radiation accounts for about 10 per cent of the energy produced in a nuclear reactor.

Nuclear radiation consists largely of alpha and beta particles and gamma rays. An *alpha particle,* which is made up of two protons and two neutrons, is identical with a helium nucleus. A *beta particle* consists of a negative electrical charge and so is identical with an electron. It results from the breakdown of a neutron in a radioactive nucleus. The breakdown also produces a proton, which remains in the nucleus. The beta particle is released as energy. Alpha and beta particles are sometimes known as alpha and beta *rays. Gamma rays* are electromagnetic waves similar to X rays (see **Electromagnetic waves**).

Scientists measure radioactive decay in units of time called *half-lives.* A half-life equals the time required for half the atoms of a particular radioactive element or isotope to decay into another element or isotope. Half-lives of radioactive substances range from a fraction of a second to billions of years. See **Isotope** (Radioactive isotopes); **Radioactivity** (Half-life).



A chain reaction results in the continuous fissioning of nuclei and so produces a steady supply of energy. To produce a chain reaction, each fissioned nucleus must give off enough free neutrons to fission at least two more nuclei, *above.* Uranium and plutonium are the materials used to produce a chain reaction.

Nuclear fission is the splitting of heavy nuclei to release their energy. All nuclear reactors produce energy in this way. To produce fission, a reactor requires a *bombarding particle,* such as a neutron, and a *target material,* such as U-235. Nuclear fission occurs when the bombarding particle splits a nucleus in the target material into two nearly equal parts, called *fission fragments.* Each fragment consists of a nucleus with about half the neutrons and protons of the original nucleus. A fission reaction releases only part of the energy of the nucleus. Most of the energy that is released takes the form of heat. The rest of the released energy takes the form of radiation.

Scientists measure nuclear energy in units called *electron volts.* The burning of one atom of carbon in coal or oil produces about 3 electron volts of energy. The fissioning of one uranium nucleus produces about 200 million electron volts.

The bombarding particle must first be *captured* by a nucleus for fission to occur. Reactors use neutrons as bombarding particles because they are the only atomic particles that are both easily captured and able to cause fission. Neutrons can also pass through most kinds of matter, including uranium. Protons can cause fission. But protons and nuclei both have a positive charge, and so they normally *repel* (push away) one another. A nucleus easily captures neutrons because they have no electric charge.

The target material. Power reactors use uranium as their target material, or fuel. A uranium nucleus is the easiest of all natural nuclei to split because it has a large number of protons. Protons naturally repel one another, and so a nucleus with many protons has a tendency to "fly apart" and can be split with little difficulty.

Uranium also makes a good nuclear reactor fuel because it can create a continuous series of fission reactions. As a result, uranium can produce a steady supply of energy. To create a series of reactions, each fissioned nucleus must give off *free* neutrons in addition to the neutrons that are bound up in its two fission fragments. A free neutron can split still another uranium nucleus, thus releasing still more free neutrons. As this process is repeated over and over, it becomes a self-sustaining *chain reaction.* Only nuclei that have many more neutrons than protons, such as uranium nuclei, can produce a nuclear chain reaction.

The U-238 isotope would make an ideal nuclear reactor fuel because it is abundant in nature. But U-238 nuclei usually absorb free neutrons without fissioning. An absorbed neutron simply becomes part of the nucleus. The scarce uranium isotope U-235 is the only natural material that nuclear reactors can use to produce a chain reaction.

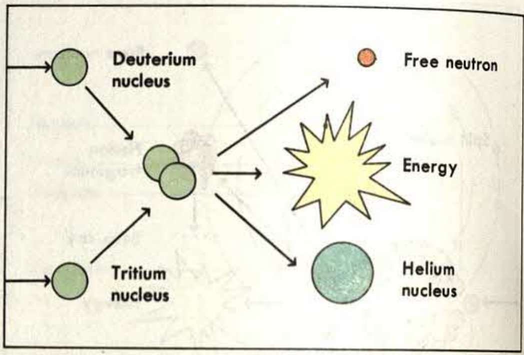
It is extremely difficult to separate the U-235 from the U-238 in uranium ore. For this reason, the fuel used by commercial power reactors contains many more U-238 atoms than U-235 atoms. To ensure capture by a U-235 nucleus rather than by a U-238 nucleus, a reactor must use *slow* neutrons as bombarding particles. Neutrons freed during fission normally travel about 19,000 kilometres or faster per second. These *fast* neutrons pass by the scarce U-235 nuclei in the fuel too rapidly to be captured. But a slow neutron travels about 1.6 kilometres per second and has a much better chance of capture by a U-235 nucleus. Reactors contain water or other substances, called *moderators,* to slow down fast neutrons.

Scientists have developed *breeder reactors* that produce and fission the artificially made isotopes plutonium 239 or uranium 233. These fuels do not contain U-238 and so do not have to compete with U-238 nuclei for free neutrons. Most breeders can therefore use fast neutrons as bombarding particles. For this reason, such breeders are also called *fast breeder reactors.* The subsection *Nuclear energy today* discusses breeders in more detail.

Nuclear fusion occurs when two lightweight nuclei *fuse* (combine) and form a nucleus of a heavier element. The products of the fusion weigh less than the combined weights of the original nuclei. The lost matter has therefore been changed into energy.

Fusion reactions that produce large amounts of energy can be created only by means of extremely intense heat. Such reactions are called *thermonuclear reactions.* Thermonuclear reactions produce the energy of both the sun and the hydrogen bomb.

A thermonuclear reaction can occur only in a special form of matter called *plasma.* Plasma is a gas made up of free electrons and free nuclei. Normally, nuclei repel one another. But if a plasma containing lightweight atomic nuclei is heated many millions of degrees, the nuclei begin moving so fast that they break through one another's electrical barriers and fuse. See **Plasma** (In physics).

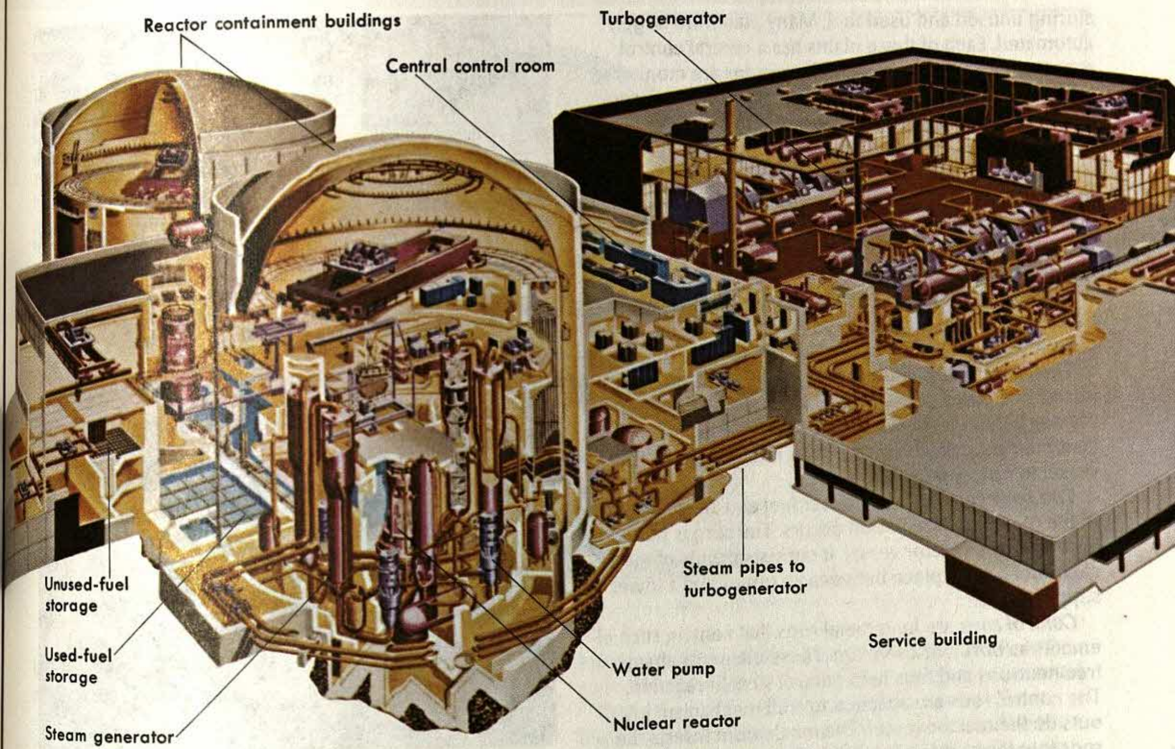


Nuclear fusion occurs when two lightweight nuclei unite and form a heavier nucleus. In the example above, nuclei of deuterium and tritium unite and form a helium nucleus. This process releases energy and a neutron. Repeated many times, fusion creates the energy of the sun and the hydrogen bomb. But scientists have yet to control fusion for use in energy production.

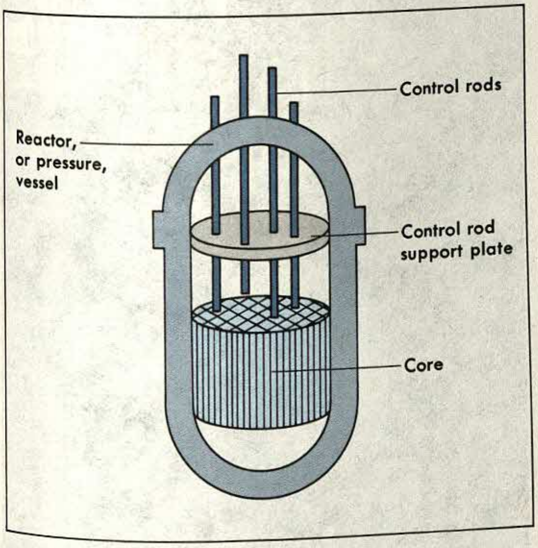
Problems of controlling fusion. Scientists have not yet succeeded in harnessing the energy of fusion to produce power. In their fusion experiments, scientists generally work with plasmas that are made from one or two isotopes of hydrogen. One such isotope is *tritium,* an artificially made radioactive isotope. Another isotope is *deuterium,* or *heavy hydrogen.* Deuterium is considered an ideal thermonuclear fuel because it can be obtained from ordinary water. A given weight of deuterium can supply about four times as much energy as the same weight of uranium.

To produce a controlled thermonuclear reaction, a plasma of deuterium or tritium or of both isotopes must be heated many millions of degrees. But scientists have yet to develop a container that can hold superhot plasma. Such extremely hot plasma expands quickly. In addition, the walls of the container must be brought to extremely low temperatures in order to keep them from melting. But if the plasma touches the walls, it becomes too cool to produce fusion. The plasma must therefore be kept away from the walls of the container long enough for its nuclei to fuse and produce usable amounts of energy.

Fusion devices. Most experimental fusion reactors are designed to contain superhot plasma in "magnetic bottles" twisted into various coillike shapes. The walls of the bottles are made of copper or some other metal. The walls are surrounded by a magnet. An electric current is passed through the magnet and creates a magnetic field on the inside of the walls. The magnetism pushes the plasma away from the walls and toward the centre of each coil. This technique is called *magnetic confinement.* All the fusion devices thus far developed, however, use much more energy than they create. The section *Nuclear energy today* discusses experimental fusion reactors in greater detail. For additional information on nuclear fusion, see **Nuclear weapon; Sun** (How the sun produces energy).



Nuclear power production requires certain basic equipment, as shown in this plan of a typical nuclear power plant. The equipment makes up two main systems. (1) The *nuclear steam supply system* includes the plant's reactor or reactors, any related steam-generating equipment, and pumps and pipes to move water and steam. Each reactor has its own *containment* building. (2) The *turbogenerator system* consists of a steam turbine and electric generator. Steam from the steam supply system spins the turbine, which drives the electric generator. The electric generator produces electricity. Other equipment includes special safety systems and storage for nuclear fuel.



A typical nuclear reactor consists mainly of a *core; control rods;* and a *reactor,* or *pressure, vessel.* The core holds the uranium that will be fissioned to create heat. The control rods regulate the chain reaction. The reactor vessel holds all other reactor parts and the water that will be heated to produce steam.

All large commercial nuclear power plants produce energy by fissioning U-235. But U-235 makes up less than 1 per cent of the uranium found in nature. More than 99 per cent of all natural uranium consists of U-238. The two types occur together in uranium ores, such as *carnotite* and *pitchblende.* Separating the U-235 from the U-238 in these ores is extremely difficult and costly. For this reason, the fuel used in reactors consists largely of U-238. But the fuel has enough U-235 to produce a chain reaction. Nuclear fuel requires special processing before and after it is used. The processing begins with the mining of uranium ore and ends with the disposal of fuel wastes. The entire process is known as the *nuclear fuel cycle.*

This section deals chiefly with the methods developed by the nuclear power industry in the United States. But the methods described resemble those used in other countries.

Power plant design. Most nuclear power plants cover 80 to 120 hectares. The majority are built near a large river or lake because nuclear plants require enormous quantities of water for cooling purposes.

A nuclear plant consists of several main buildings, one of which houses the reactor and its related parts. Another main building houses the plant's turbines and electric generators. Every plant also has facilities for storing unused and used fuel. Many plants are largely automated. Each of these plants has a central control room, where the functions of the reactor are monitored and altered by a team of specialist engineers. The control room may be in a separate building or in one of the main buildings.

The reactor building, or *containment structure,* has a thick concrete floor and thick walls of steel or of concrete lined with steel. The concrete and steel guard against the escape of radiation from an accidental leak in the nuclear reactor.

Power reactors generally consist of three main parts. They are (1) the reactor, or pressure, vessel; (2) the core; and (3) control rods.

The reactor vessel is a tanklike structure that holds the other reactor parts. It is installed near the base of the reactor building. The vessel has steel walls at least 15 centimetres thick. Steel pipes lead into and out of the vessel to carry water and steam.

The core contains the nuclear fuel and so is the part of the reactor where fission occurs. The core is near the bottom of the reactor vessel. It consists mainly of the nuclear fuel held in place between an upper and a lower support plate.

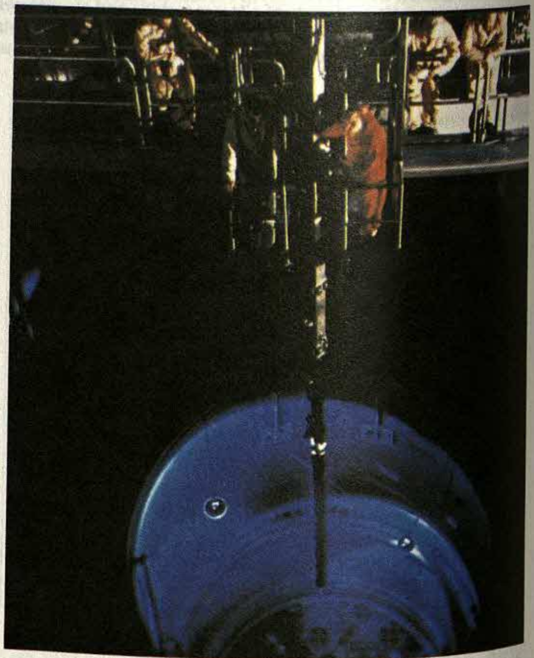
Control rods are long metal rods that contain such elements as boron or cadmium. These elements absorb free neutrons and thus help control a chain reaction. The control rods are attached to a lift mechanism just outside the reactor vessel. The mechanism inserts the rods into the core or withdraws them to slow down or speed up a chain reaction.

Reactor operations also depend on substances called *moderators* and *coolants.* A moderator is a substance, such as water or carbon, that slows down neutrons which pass through it. Reactors require a moderator because the neutrons released by fission are fast neutrons. But slow neutrons are needed to cause a chain reaction in the mixture of U-238 and U-235 that reactors use as fuel. A coolant is a substance, such as water or carbon dioxide, that conducts heat well but does not easily absorb free neutrons. The coolant carries heat from the chain reaction. By doing so, the coolant serves both to prevent the reactor core from melting and to produce steam.

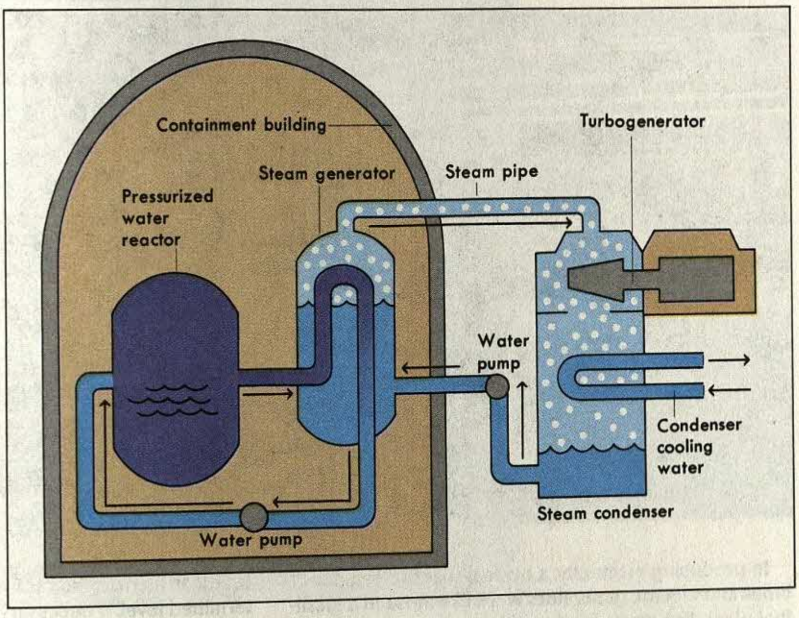
Many power reactors are *light water reactors,* which use *light* (ordinary) water as both the moderator and the coolant. The water is released into the core, where it serves as a moderator to start a chain reaction. Once the reaction has begun, the water also serves as a coolant. Many reactors in some countries use other substances as moderators and coolants. Some power reactors, for example, are *heavy water reactors.* They use deuterium oxide, or heavy water, as both the moderator and the coolant.

Fuel preparation. After uranium ore has been mined, it goes through a long milling and refining process to separate the uranium from other elements in the ore. Light water absorbs more free neutrons than do other types of moderators. The uranium used in light water reactors must therefore be *enriched*—that is, the percentage of U-235 must be increased. Free neutrons then have a better chance of striking a U-235 nucleus.

A reactor vessel is carefully lowered into place at a power plant construction site. Reactor vessels are made of heavy steel. The largest weigh more than 720 metric tons.



Refuelling a reactor. These workers are loading a new *fuel assembly* into the core of a nuclear reactor. The assembly consists of a bundle of long metal tubes filled with uranium pellets.



A nuclear steam supply system

The system shown in this diagram uses a *pressurized water reactor,* which heats water under high pressure. The pressure allows the water to heat past its normal boiling point without actually boiling. Heat from this water boils water in a *steam generator,* which produces steam. The water from the reactor is pumped back to the reactor for reuse. After the steam has operated the plant's turbine, it is sent to a *steam condenser,* which changes it back to water for reuse in the steam generator.

Uranium that has been separated from the ore is sent to an *enrichment plant.*

Enrichment plants remove varying amounts of U-238 from the uranium, depending on the intended use of the uranium. Most light water reactors require fuel that contains no more than 97½ per cent U-238 and 2½ to 3 per cent U-235. Much higher amounts of U-235 are needed in nuclear weapons and in the fuel for nuclear ships. The enriched uranium used as reactor fuel is shipped to *fuel fabrication plants.*

A fuel fabrication plant changes enriched uranium into a black powder called *uranium dioxide.* The plant then shapes the uranium dioxide powder into pellets about 8 millimetres in diameter and 13 millimetres long. The pellets are inserted into tubes made of zirconium or stainless steel. Each tube measures about 13 millimetres in diameter and 3 to 5 metres long. Free neutrons can pass through the walls of the tubes. But most other nuclear particles cannot.

After a tube has been filled with uranium dioxide pellets, its ends are welded shut. These *fuel rods* are then fastened together into bundles of 30 to 300 each. Each bundle weighs 140 to 680 kilograms and forms a *fuel assembly,* or *fuel element,* for a reactor. Commercial power reactors require 45 to 136 metric tons of uranium dioxide. The amount depends on the size of the reactor. A reactor therefore has a great many fuel assemblies in its core. The assemblies stand upright in the core between the two support plates.

Chain reactions. A reactor requires exactly the right amount of fuel to keep up a chain reaction. This amount, called the *critical mass,* varies according to the design and size of the reactor. A chain reaction will die out if the amount of fuel in the reactor falls short of the critical mass. If the fuel supply exceeds the critical mass, the reactor will overheat. And if the heat becomes intense, the core may melt. Nevertheless, reactors are designed to hold more than a critical mass of fuel. But the control rods slow down a chain reaction if it becomes too rapid.

To prepare a reactor for operation, the fuel assemblies are loaded into the core and the control rods are completely inserted. In a light water reactor, the water used as a moderator to slow down the neutrons fills the spaces between the fuel assemblies. The control rods are then slowly withdrawn, and a chain reaction begins. The farther the rods are withdrawn, the greater the intensity of the reaction because fewer neutrons are absorbed. More neutrons thus are free to cause fission. Meanwhile, the water in the core carries off the tremendous heat created by the chain reaction. To stop the reaction, the rods are again lowered all the way into the core to absorb most free neutrons.

Steam production. The light water reactors are of two main types. One type, the *pressurized water reactor,* produces steam outside the reactor vessel. The other type, the *boiling water reactor,* makes steam inside the vessel.

Most nuclear plants use pressurized water reactors. These reactors heat the moderator-water in the core under extremely high pressure. The pressure allows the water to heat past its normal boiling point of 100° C without actually boiling. The chain reaction heats the water to about 320° C. Pipes carry this extremely hot, though not boiling, water to steam generators outside the reactor. Heat from the pressurized water boils water in the steam generator and so produces steam.

In a boiling water reactor, the chain reaction boils the moderator-water in the core. Pipes carry the steam produced from the reactor to the plant's turbines. Most nuclear reactors in the United Kingdom are gas cooled. Carbon dioxide flows over the fuel in the core and conducts heat away to steam generators. The reactors are called Magnox reactors because the uranium fuel is contained in cans made from a magnesium alloy.

The central control room of a large nuclear power plant contains hundreds of electronic devices. Some of the devices help regulate production operations. Others monitor the plant's many safety systems.

In producing electricity, a nuclear plant's steam turbines and electric generators work like those in a fossil-fuel plant. The steam produced by a reactor spins the blades of the plant's turbines, which drive the generators. Many plants have combination turbines and generators called *turbogenerators.*

After steam has passed through a plant's turbines, it is piped to a *condenser.* The condenser changes the steam back into water. A reactor can thus use the same water over and over. But a condenser requires a constant supply of fresh water to cool the steam. Most plants pump this water from a nearby river or lake. The water, which becomes warm as it passes through the condenser, is then pumped back into the river or lake. This warm waste water may cause a kind of water pollution called *thermal pollution,* which may endanger plant and animal life in some rivers and lakes where it occurs.

To help solve the problem of thermal pollution, most new nuclear plants have *cooling towers.* Hot water from the steam condensers is moved through the towers in such a way that the heat passes into the atmosphere as steam or water vapour. The cooled water is returned to the steam condenser for reuse.

Hazards and safeguards. An ordinary power reactor cannot explode like an atomic bomb. Only a *supercritical* mass of plutonium 239 or of greatly enriched uranium 235 can cause such an explosion. A supercritical mass contains more than the amount of plutonium or uranium required to sustain a chain reaction.

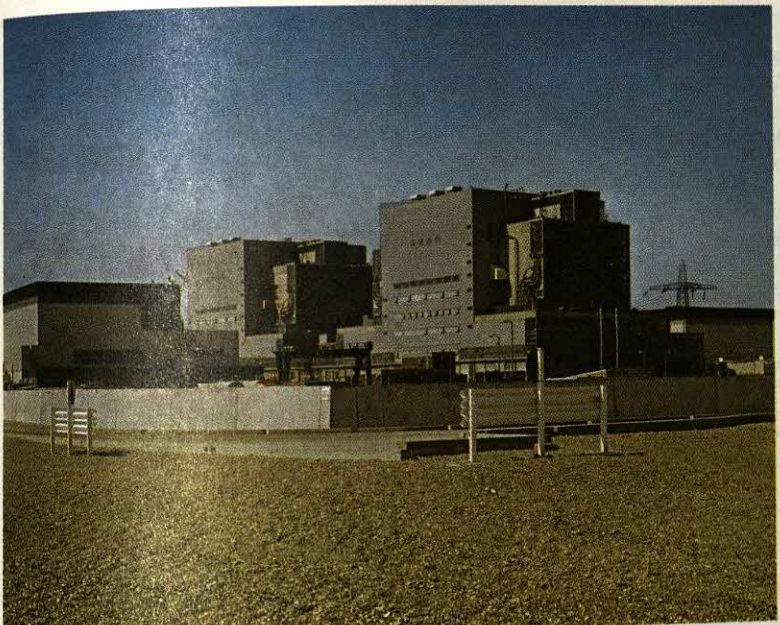
The chief hazards of nuclear power production result from the great quantities of radioactive material that a reactor produces. These materials give off radiation in the form of alpha, beta, and gamma rays. The reactor vessel is surrounded by thick concrete blocks called a *shield,* which normally prevents almost all radiation from escaping.

In countries with nuclear energy, regulations limit the amount of radiation allowed from nuclear plants. Every plant has instruments that continuously measure the radioactivity in and around the plant. They automatically set off an alarm if the radioactivity rises above a predetermined level. If necessary, the reactor is shut down.

A plant's routine safety measures greatly reduce the possibility of a serious accident. Nevertheless, every plant has emergency safety systems. Possible emergencies range from a break in a reactor water pipe to a leak of radiation from the reactor vessel. Any such emergency automatically activates a system that instantly shuts down the reactor, a process called *scramming.* Scramming is usually accomplished by the rapid insertion of the control rods into the core.

A leak or break in a reactor water pipe could have serious consequences if it results in a loss of coolant. Even after a reactor has been shut down, the radioactive materials remaining in the reactor core can become so hot without sufficient coolant that the core melts. This condition, called a *meltdown,* could result in the release of dangerous amounts of radiation. In most cases, the large containment structure that houses a reactor would prevent the radioactivity from escaping into the atmosphere. However, there is a small possibility that the molten core could become hot enough to burn through the floor of the containment structure and go deep into the earth. Nuclear engineers call this type of situation the "China syndrome." To prevent such an accident from occurring, all reactors are equipped with an *emergency core cooling system,* which automatically floods the core with water in case of a loss of coolant.

Wastes and waste disposal. The fissioning of U-235 produces more free neutrons than are needed to continue a chain reaction. Some of them combine with U-238 nuclei, which far outnumber U-235 nuclei in the reactor fuel. When U-238 captures a neutron, it is changed into U-239. The U-239 then decays into neptunium 239 (Np-239), which decays into plutonium 239 (Pu-239). This same process forms Pu-239 in a breeder reactor. Slow neutrons can fission Pu-239, as well as U-235. Some of the newly formed Pu-239 is thus fissioned during the fissioning of U-235. The rest of the Pu-239 remains in the fuel assemblies.



Nuclear power plants in Britain generally use the gas-cooled reactor principle. In 1990, Britain shelved plans to further develop its nuclear power capacity as evidence of inefficient operation came to light.

The fissioning of U-235 also produces many other radioactive isotopes, such as strontium 90, caesium 137, and barium 140. These wastes remain radioactive and dangerous for about 600 years because of the strontium and caesium isotopes. After that time, enough of the strontium and caesium will have decayed into stable isotopes so that they no longer present a problem. However, the plutonium and other artificially created elements in the wastes remain radioactive for thousands of years. Even in small amounts, plutonium can cause cancer or *genetic* (reproductive) damage in humans. Larger amounts can cause radiation sickness and death (see **Radiation sickness**). Safe disposal of these wastes is one of the problems involved in nuclear power production.

Most nuclear plants need to replace their fuel assemblies only about once a year. The radioactive wastes generate heat, and so used fuel assemblies must be cooled after removal from a reactor. Nuclear plants cool the assemblies by storing them underwater in specially designed *storage pools.*

Several governments are working on guidelines for the safe and permanent disposal of nuclear wastes. One plan involves the wide-scale use of commercial *reprocessing plants* to reduce the disposal problem. Under this plan, nuclear plants would ship their used fuel assemblies to the reprocessing plants for removal of Pu-239 and unused U-235. These radioactive isotopes would then be recycled into fuel for nuclear reactors. However, this method would leave radioactive isotopes in the chemical solutions used for reprocessing. To prevent accidental seepage of the solutions, they would have to be changed into a solid form that could be safely stored.

Experts have established that it would be possible to isolate long-lived nuclear wastes from the environment for thousands of years. Several methods of permanent storage in underground sites are still under study. As a result, many nuclear power plants continued to store their used fuel assemblies in underground pools of water on the plant grounds.

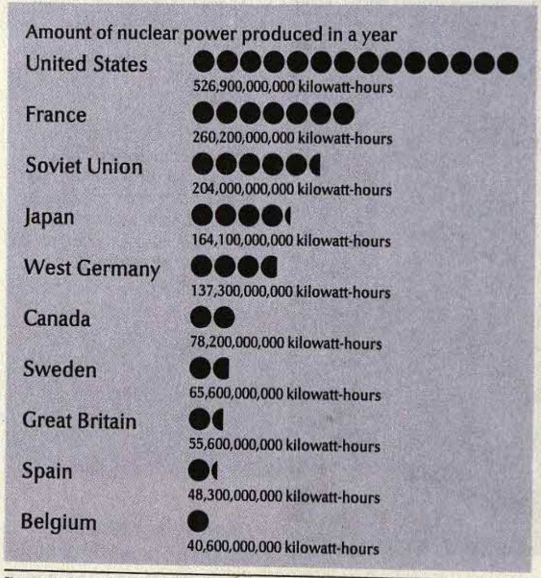
The nuclear energy industry

In every country that has a nuclear energy industry, the government plays a role in the industry. But the nature and extent of the government's role vary greatly among countries. In most industrialized countries and in several developing countries, nuclear reactors provide a part of the total electric energy production. In a few countries, such as France, Belgium and Sweden, most of the electric energy is produced by nuclear power. One of the main reasons for the switch to nuclear power in these countries was to avoid dependence on oil-exporting countries that are politically unstable. Some countries, such as Australia and New Zealand, do not operate nuclear power stations.

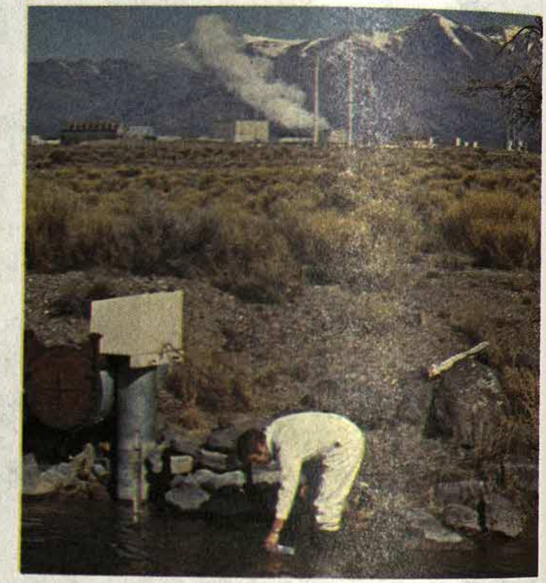
About one-fifth of all Britain's electricity comes from 14 nuclear power stations. The Central Electricity Generating Board (CEGB) controls 12 of them. The South of Scotland Electricity Board controls the other two. Two prototype reactors run by the United Kingdom Atomic Energy Authority (UKAEA) and two run by British Nuclear Fuels Ltd (BNFL) also provide a small amount of electricity for public use.

In the United States, private utility companies own most of the nuclear power plants. About 280 plants in 25 countries produce approximately 2 per cent of the world's energy. But the growth of nuclear energy has been slowed down by rising costs.

Leading nuclear power producing countries



Figures are for 1988; West Germany figure is for period before reunification.
Source: U.S. Energy Information Administration.



Samples of river water taken near a nuclear plant are tested for radioactivity, as are samples of the soil and air. Nuclear plants release some radioactive gas into the environment. But the amounts are normally too small to be considered harmful.

The industry and the economy. The main economic advantage claimed for nuclear power plants is that the fuel is cheaper and so they cost less to operate than fossil-fuel plants do. But nuclear plants cost more to build and to dismantle after their useful life than do fossil-fuel plants.

Under normal economic conditions, a nuclear plant's savings in fuel eventually make up for its higher construction expenses. At first, these expenses add to the cost of producing electricity. But after some years, a plant will have paid off its construction costs. It can then produce electricity more cheaply than a fossil-fuel plant can. But two main problems—sharply higher costs and equipment failures—have somewhat lessened this long-run economic advantage of nuclear power plants. Many nuclear plants have to be shut down for months at a time because of equipment failures. Such losses of operating time add to the cost of producing electricity.

The industry and the environment. A nuclear plant releases small amounts of radioactive gas into the air. In addition, the cooling water used in pressurized water plants picks up a small amount of *tritium* (radioactive hydrogen) in the steam condenser. The tritium remains in this water when it is returned to a river or lake. But these small amounts of radiation released into the environment are not believed to be harmful. Thermal pollution remains a problem at some nuclear plants. But cooling towers help correct this problem.

Unlike fossil-fuel plants, nuclear plants do not release solid or chemical pollutants into the atmosphere. However, when a serious accident occurs, radioactivity can be released into the atmosphere and endanger people in surrounding areas. Such an accident occurred in Ukraine in 1986. Critics of nuclear power believe that the possibility of a serious accident increases with the number of nuclear plants. The subsection *Hazards and safeguards* earlier in this article discusses the main methods of guarding against accidents.

Critics of nuclear power also fear another danger to the environment. As power production increases, the creation of high-level radioactive wastes also increases. These wastes remain extremely radioactive for about 600 years because they contain the isotopes strontium 90 and caesium 137. The wastes also contain plutonium and other artificially created heavy elements, so they will remain strongly radioactive for thousands of years. The problem of storing radioactive wastes is discussed in the subsection *Wastes and waste disposal.*

The development of nuclear energy

In 1972, scientists discovered that a natural chain reaction had occurred nearly 2 billion years ago in a uranium deposit in west-central Africa. Two billion years ago, radioactive decay had not progressed so far as it has today. The uranium ore therefore contained enough U-235 to start a chain reaction. An accumulation of ground water acted as a moderator to begin the reaction. As heat from the reaction changed the water into steam, less and less water was available to serve as a moderator and the reaction died out. Except for such rare natural occurrences, nuclear energy was not released on a large scale on the earth until 1942. That year, scientists produced the first artificially created chain reaction. Scientific discoveries that took place within the last 100 years made the large-scale release of nuclear energy possible.

Early developments

In 1896, the French physicist Antoine Henri Becquerel found that uranium gives off energy in the form of invisible rays. He thus became the discoverer of natural radioactivity. Other scientists soon began experiments to learn more about this mysterious form of energy.

The beginning of nuclear physics. Between 1899 and 1903, the great British physicist Ernest Rutherford found that some radioactive rays consist of high-energy particles. He discovered two kinds of radioactive particles, which he named *alpha* and *beta* particles. Experiments with these particles then led Rutherford to discover the atom's nucleus. This achievement, which Rutherford announced in 1911, marked the beginning of a new science—nuclear physics.

About 1914, scientists began trying to split light nuclei with alpha particles from naturally radioactive materials. Light nuclei do not repel positively charged particles, such as alpha particles, as strongly as heavy nuclei do. In 1919, Rutherford changed nitrogen into oxygen by this method. He thus achieved the first artificially created transmutation of one element into another. Oxygen weighs more than nitrogen. The reaction therefore consumed more energy, in the form of the alpha particle, than it produced. Although Rutherford did not succeed in producing fission, he showed that the structure of a nucleus can be changed.

The first artificially created fission reaction. To produce fission, a particle was needed that heavy nuclei would not repel. In 1932, the British physicist James Chadwick discovered such a particle—the neutron. In 1938, two German radiochemists, Otto Hahn and Fritz Strassmann, reported they had produced the element barium by bombarding uranium with neutrons.

At first, scientists could not explain how uranium had produced barium, which is much lighter than uranium. All previous transmutations had resulted in an element about as heavy as the original one. Then in 1939, the Austrian physicist Lise Meitner and her nephew Otto Frisch showed that Hahn and Strassmann had in fact produced the first known artificially created fission reaction. A uranium nucleus had split into two nearly equal fragments, one of which consisted of a barium nucleus. Two neutrons were also emitted. The other fragment consisted of a nucleus of krypton, a somewhat lighter element than barium. These two nuclei, together with the emitted neutrons, weigh less than a uranium nucleus and a neutron. The reaction had therefore produced more energy than it consumed.

Scientists soon realized that if uranium produced a chain reaction, it would release tremendous energy. To find how much energy a chain reaction would release, scientists used a theory developed by the great German-born physicist Albert Einstein in 1905. The theory states that matter is a form of energy and that matter and energy are related by the equation $E=mc^2$. This equation states that the *energy* (E) in a substance equals the *mass* (m) of that substance multiplied by the *speed of light squared* (c^2). Light travels 299,792 kilometres per second. The speed of light squared is obtained by multiplying the speed of light by itself. Using this equation, scientists determined that the fissioning of 0.45 kilogram of uranium would release as much energy as 7,300 metric tons of TNT. Uranium could therefore be used to make a powerful bomb. See **$E=mc^2$**.

The beginning of the nuclear age

The development of nuclear weapons. World War II broke out in Europe in September 1939. The month before, Einstein had written to U.S. President Franklin D. Roosevelt urging him to commit the United States to developing an atomic bomb. Einstein had fled to the United States from Germany to escape Nazi persecution. He warned Roosevelt that German scientists might already be working on a nuclear bomb. Roosevelt acted

Important dates in nuclear energy development

1896	Antoine Henri Becquerel, a French physicist, discovered natural radioactivity.
1905	The great German-born physicist Albert Einstein published his theory that matter is a form of energy and that mass and energy are related.
1911	The British physicist Ernest Rutherford announced his discovery of the nucleus of the atom.
1932	James Chadwick, a British physicist, discovered the neutron.
1938	The German radiochemists Otto Hahn and Fritz Strassmann produced the elements barium and krypton by bombarding uranium with neutrons.
1939	The Austrian physicists Lise Meitner and Otto Frisch showed that Hahn and Strassman had produced the first known artificially created fission reaction.
1942	A group of scientists headed by the Italian-born physicist Enrico Fermi produced the world's first artificially created chain reaction at the University of Chicago. The achievement made possible the development of the atomic bomb.
1945	The United States exploded the first atomic bomb near Alamogordo, New Mexico
1952	The U.S. Atomic Energy Commission built the first breeder reactor. It produces plutonium at the same time it produces energy from uranium.
1952	The United States exploded the first hydrogen bomb at Eniwetok, a small island in the Pacific Ocean, and so produced the world's first large-scale fusion reaction.
1956	The first full-scale nuclear power plant began operations at Calder Hall in England.
1957	The United Nations (UN) established the International Atomic Energy Agency to promote the peaceful uses of nuclear energy. The first full-scale U.S. nuclear power plant opened in Shippingport, Pennsylvania.
1957	Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany formed the European Atomic Energy Community (Euratom).
1973	Great Britain, Ireland, and Denmark joined Euratom.

on Einstein's urging, and early in 1940 scientists received the first funds for uranium research in the United States. They sought to discover a method of preparing enough plutonium or greatly enriched uranium for a bomb. The United States entered World War II in 1941. The U.S. government then ordered an all-out effort to perfect an atomic bomb and established the top-secret Manhattan Project to achieve this goal (see **Manhattan Project**).

A group of scientists at the University of Chicago had charge of producing plutonium for the Manhattan Project. The group included such noted physicists as Enrico Fermi, Leo Szilard, and Eugene Wigner, all of whom had been born in Europe and had settled in the United States. Fermi headed the group. Under the scientists' direction, workers built an atomic *pile,* or reactor, beneath the stands of the university athletic field. The pile consisted of 45 metric tons of natural uranium embedded in 450 metric tons of graphite. The graphite served as a moderator. The pile was designed to start a chain reaction in the uranium, which would then produce plutonium by radioactive decay. Cadmium rods controlled the reaction. On Dec. 2, 1942, this primitive reactor produced the first artificially created chain reaction.

The success of the University of Chicago project led the U.S. government to build a plutonium-producing plant in Hanford, Washington. The government also built a uranium enrichment plant in Oak Ridge, Tennessee. Plutonium and greatly enriched uranium from these plants were used in the atomic bombs dropped on Japan by the United States in August 1945. The bombs ended the war.

After World War II, scientists began work on developing a hydrogen bomb. The United States exploded the first hydrogen bomb in 1952 and so achieved the world's first large-scale thermonuclear reaction. The Soviet Union tested its first atomic bomb in 1949 and its first full-scale hydrogen bomb in 1953. China, France, Great Britain, and India have also exploded nuclear weapons. For more information on the development of nuclear weapons, see **Nuclear weapon.**

The first peaceful uses. While research on nuclear weapons continued, various countries also began experimenting with nuclear reactors. The United States and the Soviet Union had built uranium enrichment plants during the war. Both countries therefore started to develop light water reactors, which require enriched uranium fuel. Canada, France, and Great Britain began work on reactors moderated by graphite or heavy water. These reactors cost more to build than light water reactors, but they use unenriched uranium.

The U.S. Congress set up the Atomic Energy Commission (AEC) in 1946 to direct and control all aspects of nuclear energy development in the United States. In 1954, Congress allowed private industry to take over most aspects of commercial nuclear power development. But the AEC became responsible for regulating the nuclear energy industry. It also kept control in such areas as uranium enrichment and waste disposal.

The United States made the world's first full-scale use of controlled nuclear energy in 1954. That year, the U.S. Navy launched the first nuclear-powered vessel, the submarine *Nautilus.* The first full-scale nuclear power plant began operations in 1956 at Calder Hall in northwestern England. In 1957, the first large-scale nuclear plant in the United States opened in Shippingport, Pennsylvania. It supplied electricity to the Pittsburgh area until 1982, when the plant was closed. Canada opened its first full-scale plant in 1962 at Rolphton, Ontario.

The successful start of the nuclear power industry convinced world leaders of the need for international cooperation in the field. In 1957, the United Nations (UN) established the International Atomic Energy Agency to promote the peaceful uses of nuclear energy (see **International Atomic Energy Agency; United Nations** [Peaceful uses of nuclear energy]). Also in 1957, Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany formed the European Atomic Energy Community (Euratom). The organization encourages the development of nuclear power among its member countries. Denmark, Britain, and Ireland joined Euratom in 1973.

Nuclear energy today

The spread of nuclear capability. During the 1960's and early 1970's, a number of countries acquired reactors and used them to start nuclear power development. Progress was also made during this period toward limiting nuclear weapons tests and stopping the spread of nuclear weapons. In 1970, for example, a nuclear *nonproliferation treaty* went into effect. The treaty prohibits the nuclear powers that signed and ratified the document from giving nuclear weapons to nations that do not already have them. The nonproliferation treaty also prohibits nations without nuclear weapons from acquiring such weapons.

But the nonproliferation treaty does not prohibit nations from selling or buying nuclear reactors. A reactor can be used not only for peaceful purposes but also to produce plutonium for nuclear weapons. India used a research reactor for this purpose and in 1974 exploded its first atomic bomb. Canada had supplied the reactor to India with the understanding it would be used for peaceful purposes only. Canada has signed the nonproliferation treaty, but India has not. Critics of India's action question the wisdom of supplying reactors to countries that do not already have them.

Meanwhile, the United States had been greatly increasing its nuclear power capacity. But opposition to nuclear power development also increased in the United States and other countries during the late 1960's and early 1970's. Critics began to question nearly every aspect of nuclear power production, from the cost of uranium enrichment to the problems of waste disposal.

Many critics of nuclear programmes charged that the governments overlooked various safety risks at nuclear plants to promote nuclear power development.

Research on new types of reactors was sparked by fears of a shortage of U-235 to fuel fission reactors. However, during the 1970's, nuclear power production increased less rapidly than anticipated, and the expected shortage did not occur. Today, scientists seek to develop safer and more efficient reactors. Researchers have concentrated their efforts on the development of a fusion reactor and commercial breeder reactor.

Experimental fusion devices. Most experimental efforts to produce energy from nuclear fusion have concentrated on using a superhot plasma of heavy hydrogen as the fuel. Heavy hydrogen could supply almost unlimited amounts of power because it is obtained from ordinary water. Some scientists have attempted to achieve nuclear fusion of heavy hydrogen at room temperatures. But the experiments have been met with disbelief. Few experts believe that any kind of workable fusion device can be perfected in the 1900's.

The most successful fusion reactor, called a *tokamak,* was originally designed by Soviet scientists. Tokamak means *strong current* in Russian. Like other experimental fusion reactors, a tokamak uses a magnetic field to push plasma away from its containing walls. It also passes a strong current through the plasma. The current acts with the magnetic field to help confine the plasma.

Scientists in the United States and other countries also have developed tokamaks. But no tokamak has yet produced usable amounts of energy. Plasma must be heated to at least 100,000,000° C to produce a controlled thermonuclear reaction. But plasmas are difficult to contain at such temperatures.

Another experimental method to achieve fusion uses beams of *laser light* to compress and heat tiny pellets of frozen deuterium and tritium. This process creates miniature thermonuclear explosions that release energy before the pellets reach the containing walls. But all experiments with this method have not yet produced usable amounts of energy. See **Laser.**

Experimental breeder reactors. The most important type of experimental breeder uses the plentiful uranium isotope U-238 as its basic fuel. The reactor changes the U-238 into the isotope plutonium 239 (Pu-239) by radioactive decay. Like U-235, Pu-239 can create a chain reaction and so can be used for energy production. Another breeder uses the natural element thorium as its basic fuel. It changes the thorium into the isotope U-233, which can also produce a chain reaction.

Several countries have built experimental breeders. The French breeder, called the Phénix, is the most successful. It regularly produces 250,000 kilowatts of electricity. But no country yet has a breeder suitable for large-scale commercial use.

An experimental fusion device called a *tokamak* uses a superhot plasma of heavy hydrogen to produce a nuclear reaction.

Safety concerns. There have been a number of accidents at nuclear power plants. Most of them have not been serious. However, concerns about the safety of nuclear power production increased after the serious accident in 1979 at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania in the United States. Mechanical and human failures resulted in a breakdown of the reactor's cooling system and the destruction of the reactor's core. Scientists and technicians succeeded in preventing a total core meltdown that might have released large amounts of radioactive isotopes into the area surrounding the plant. Cleanup of the plant continued in the late 1980's.

The worst nuclear accident in history occurred in 1986 at the Chernobyl nuclear power plant near Kiev in Ukraine, which was then part of the Soviet Union. An explosion and fire ripped apart the reactor and released large amounts of radioactive isotopes into the atmosphere. Unlike most Western reactors, the Chernobyl reactors lacked an enclosure to prevent radioactive isotopes from escaping. Clouds of radioactive debris drifted across Europe.

Thirty-one people died from radiation sickness or burns, and more than 200 others were seriously injured. The radioactivity spread over the eastern part of what was then the Soviet Union and was carried by wind into northern and central Europe. Experts expected a significant increase in the number of cancer deaths among those near the reactor. But they predicted that the health effects outside the Chernobyl area would be slight.

As a result of the accidents at Three Mile Island and Chernobyl, opposition to nuclear power increased in many countries during the late 1980's. Many experts believed the safety problems could be solved, and some countries planned to expand their nuclear power facilities.

Research continued on the development of safer reactors. For example, engineers were working on a reactor that used graphite as a moderator and layers of ceramics and carbon, rather than metal, to enclose the fuel rods. The engineers claimed that such a reactor could not melt down.

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Outline

I. The role of nuclear energy in power production
  A. Worldwide distribution of nuclear energy
  B. Advantages and disadvantages of nuclear energy
  C. The full development of nuclear energy
II. The science of nuclear energy
  A. The composition of matter
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  A. Power plant design
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  E. Steam production
  F. Hazards and safeguards
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IV. The nuclear energy industry
  A. Organization of the industry
  B. The industry and the economy
  C. The industry and the environment
  D. Government regulation
V. The development of nuclear energy

Questions

What two advantages do nuclear power plants have over fossil-fuel plants?
What is a chain reaction?
What is *U-235*? Why are scientists seeking a replacement for it?
How does a nuclear reactor produce fission?
What part did Ernest Rutherford play in the development of nuclear energy?
What is *radioactive decay*? *Nuclear radiation*?
What kinds of wastes are formed in power reactors?

Nuclear engineering. See **Engineering** (Nuclear engineering).

Nuclear fission. See **Fission; Nuclear energy.**

Nuclear force. See **Grand unified theories.**

Nuclear magnetic resonance (NMR). See **Magnetic resonance imaging.**

Nuclear medicine. See **Isotope** (Uses of radioisotopes).

Nuclear Nonproliferation Treaty. See **Nuclear weapon** (Nonproliferation); **United Nations** (Arms control).

Nuclear physics is the branch of physics that studies the properties, structure, and reactions of atomic nuclei. Nuclear physics began around 1900 with the discovery of radioactivity and the nucleus. Since then, the development of increasingly powerful and precise tools has enabled physicists to study nuclei in ever greater detail.

The nucleus contains over 99.9 per cent of an atom's mass. It consists of two kinds of particles, *neutrons* and *protons,* with nearly identical masses. Protons have a positive electrical charge, and neutrons have none. The number of protons in a nucleus determines what chemical element the atom belongs to, while the neutron number determines what *isotope* of that element it represents. See **Isotope.**

A powerful force called the *strong interaction* or *nuclear force* binds the neutrons and protons in the nucleus and packs them closely together. Thus, all nuclei have the same extremely high density. If the earth were compressed until it had the density of an atomic nucleus, its diameter would be only about 0.5 kilometre.

Nuclei with different numbers of protons and neutrons can have remarkably different properties. Some nuclei are shaped like spheres, while others are slightly elongated or slightly flattened. Some nuclei are rigid, while others are more flexible. Some are stable, while others are radioactive and spontaneously release radiation called *alpha particles, beta particles,* and *gamma rays* in order to take a more stable form. Physicists explain these properties using sophisticated theories that allow them to predict the behaviour of new kinds of nuclei.

Much of the information about atomic nuclei comes from studies of nuclear reactions. Typically, a *particle accelerator* is used to create tiny, high-velocity beams of protons, neutrons, or other particles. A nuclear reaction occurs when one of these particles strikes a nucleus. Physicists then use high-precision tools to analyse the radiations emitted during the reaction.

Nuclear reactions are used in both nuclear energy and nuclear weapons. The *fission* (splitting) of very heavy nuclei and the *fusion* (combining) of two very light nuclei both release large amounts of energy. Usually, this energy is released in a slow, controlled way. Fission energy is used to generate electricity and to power ships, and researchers are working on devices to turn fusion energy into electricity. In nuclear weapons, very different conditions force a large number of fission or fusion reactions to occur nearly simultaneously, producing an atomic bomb or hydrogen bomb explosion.

Research in nuclear physics has led to new techniques for diagnosing and treating disease, sterilizing and preserving food, and exploring for oil. Often, these techniques make use of radioactive nuclei called *radioisotopes.* Nuclear research is also useful in other branches of physics and in such fields as astrophysics, biochemistry, and chemistry.

See also **Atom; Nuclear energy; Nuclear weapon; Particle physics; Radioactivity.**

Nuclear power. See **Nuclear energy.**

Nuclear reactor is a device that produces a vast amount of energy from a small amount of fuel. It is sometimes called an *atomic reactor* or an *atomic pile.* A nuclear reactor generates energy mainly in the form of heat by means of a process known as *nuclear fission.* Nuclear fission is the splitting of the nuclei of atoms of uranium or plutonium.

Nuclear reactors provide the heat to power electrical power stations, large ships, and submarines. The heat is usually used to boil water which produces the high-pressure steam that drives steam turbines. No economic method has yet been developed that converts nuclear energy directly into other forms of energy.

An atomic bomb gets its destructive power from uncontrolled fission. A nuclear reactor, however, keeps fission under control. As a result, the energy it produces can be used for the generation of electricity and for other peaceful purposes. Reactors also are used to make various substances radioactive. These radioactive materials, called *radioisotopes,* have important uses in agriculture, industry, and medicine.

Parts of a nuclear reactor

Nuclear reactors vary in design and size. But most of them have five basic parts: (1) the core, (2) the moderator, (3) the control rods, (4) the coolant, and (5) the pressure vessel. They also have a biological shield and a safety system to protect reactor operators and technicians, as well as the general public.

The core is the central part of a reactor. It consists of the nuclear fuel. The fission process occurs in the core.

The nuclear fuel used by most reactors is a mixture of several *isotopes* (forms) of uranium. Only one of these isotopes, U-235, actually undergoes fission. But a special type of reactor, called a *breeder reactor,* can convert one of the other more abundant isotopes, U-238, to fissionable plutonium, Pu-239.

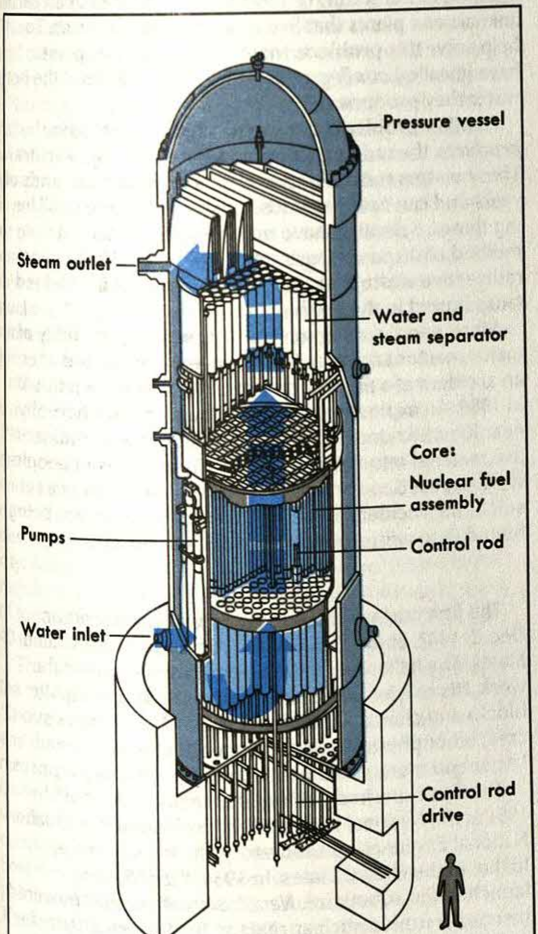
In a reactor that uses uranium fuel, fission occurs when the nucleus of a U-235 atom captures a neutron, a heavy uncharged atomic particle. The U-235 nucleus then splits into two smaller nuclei called *fission fragments,* releasing energy and several neutrons. These neutrons strike other uranium nuclei and cause them to break apart. These splittings, in turn, give off additional neutrons, which split still more nuclei. This self-sustaining series of fissions in the nuclear fuel is called a *chain reaction.* Such a process can cause trillions of atoms to fission within a fraction of a second—and produce an enormous amount of energy.

The moderator is a material used in many reactors to increase the probability of fission and thus promote a chain reaction. Most moderators consist of graphite, water, or *heavy water,* a compound of oxygen and deuterium. Such a substance slows down the neutrons released by U-235 atoms during fission. By doing so, the moderator enables other U-235 atoms to capture the neutrons more readily and to split in turn. If a moderator did not reduce the neutrons' speed, many neutrons would be absorbed by U-238 atoms, which do not fission.

The control rods regulate the rate of a chain reaction. They are made of boron, cadmium, or some other element that can absorb neutrons without being changed by them.

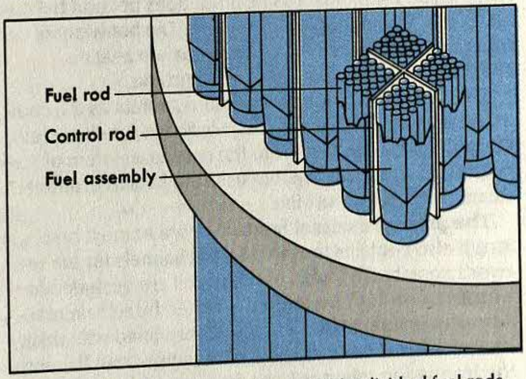
After loading the core with fuel, the operator of the reactor partially withdraws the control rods so that they absorb a relatively small number of neutrons. This action allows a chain reaction to become self-sustaining. The operator then inserts the rods partway into the core to absorb enough neutrons to slow the reaction and

Parts of a nuclear reactor

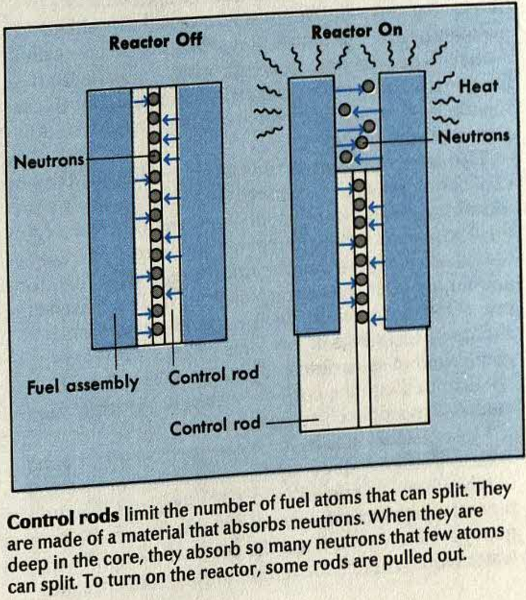


The core is the heart of a nuclear reactor. Nuclear fuel in the core produces heat. Water or some other cooling material carries the heat to the machinery run by the reactor. A pressure vessel encloses the core and holds the cooling material.

How a reactor works



Fuel assemblies in the reactor's core hold individual fuel rods that contain atoms of nuclear fuel. As the fuel nuclei split, they produce energy and release neutrons. Other fuel nuclei split when struck by the neutrons, and thus the reaction continues.



Control rods limit the number of fuel atoms that can split. They are made of a material that absorbs neutrons. When they are deep in the core, they absorb so many neutrons that few atoms can split. To turn on the reactor, some rods are pulled out.

prevent an explosion. If the operator wishes to increase the power level of the reactor, the control rods can be partly withdrawn to free more neutrons and speed up the reaction.

The coolant carries the intense heat produced by fission out of a reactor. It makes the heat available to other systems of a nuclear power plant for the generation of electricity. At the same time, the coolant controls the temperature of the reactor core and prevents it from overheating. Various substances, including gases, liquids, and liquid metals, can be used as a coolant.

Reactors can be classified according to their coolant and the way they use it. For example, a *gas-cooled reactor* uses carbon dioxide or helium to transport heat to a steam generator outside the core of the reactor. The generator makes steam for a turbine that drives an electric generator. Two other types of reactors use water as the coolant. In a *boiling-water reactor,* the heat of the core causes the water to boil and turn to steam. The steam then flows from the reactor to a turbine connected to an electric generator. In a *pressurized-water reactor,* the water absorbs heat but does not boil because it is kept under high pressure. The hot water is transferred from the reactor to a separate heat exchanger that produces steam for a turbine.

Some breeder reactors use liquid sodium as the coolant. In a *liquid-metal-cooled fast breeder,* for example, the sodium carries heat from the core to a system of *heat exchangers.* This system uses the heat to produce steam that drives a turbine.

The pressure vessel holds the core of most reactors. It also contains the circulation channels for the reactor's coolant. The walls of the vessel are designed to withstand the high pressure generated by a chain reaction. In most cases, the vessel walls are lined with thick steel slabs to reduce the flow of radiation from the core. Nuclear fission releases large amounts of penetrating neutrons and *gamma rays* (electromagnetic rays of extremely high energy). Both neutrons and gamma rays can harm people.

The biological shield consists of thick concrete blocks that surround the pressure vessel. The shield protects people from radiation exposure. Concrete absorbs the gamma rays and neutrons that escape from the pressure vessel. Special instruments monitor the radiation level around the shield continuously to make sure no leaks occur.

The safety system includes devices designed to prevent serious reactor accidents. One such device is a set of *safety rods* that permits the rapid shutdown of a reactor. These rods, which function like control rods, are automatically inserted into the reactor core when neutron-counting instruments detect an abnormal increase in the rate of fission. A similar device, used for emergency shutdowns, consists of tiny balls of *samarium oxide,* a compound of samarium and oxygen. When these balls are dropped into the core, they quickly absorb enough neutrons to stop a chain reaction.

Most reactors also have an *emergency core cooling system.* This emergency system keeps the core from overheating if its coolant is lost. For example, if a coolant pipe of a pressurized-water reactor ruptured, the emergency system would flood the core with water. The water would reduce the temperature of the core and prevent a *meltdown* (melting of nuclear fuel).

If a meltdown occurred, large amounts of dangerous radioactive materials could be released from the reactor. To prevent the escape of radioactivity to the surrounding area, most power-reactor installations are enclosed in a leak-proof *containment structure.* Filters and similar devices trap and clear away most of the radioactive particles in the containment structure. Airtight compartments called *air locks* enable technicians to leave the structure without affecting the containment system.

Reactors and the environment

Nuclear reactors produce electric power without burning such fuels as coal or oil. They thus help conserve the world's supply of these fuels. Reactors also do not give off smoke or gases that pollute the air. But they do create some new problems.

Nuclear power plants generate more excess heat than do power plants that burn coal or oil. Therefore, they need more water to cool their systems and, in turn, dump more hot waste water into lakes and streams. This addition of hot water, called *thermal pollution,* can harm animals and plants that live at lower temperatures. To help solve this problem, many nuclear power plants have installed *cooling towers* that use air to cool the hot water they produce.

Another problem involves the disposal of *fission products,* the radioactive wastes produced by reactors. These wastes remain highly radioactive for thousands of years and can cause serious radiation damage to all living things. Scientists have not found a permanent method of disposal. During the 1960's and 1970's, most radioactive waste from reactors was stored in shielded tanks buried in the earth.

Many people are concerned about the possibility of a major reactor accident. Such concerns increased after an accident at a nuclear power plant in the Soviet Union in 1986. An explosion and fire at the plant, at Chernobyl, near Kiev, Ukraine, released large amounts of radioactive material into the atmosphere. Thousands of people were exposed to dangerous levels of radiation as a result of the accident. Few new nuclear reactors are being built due to widespread concern about safety.

History

The first nuclear chain reaction was produced on Dec. 2, 1942, at the University of Chicago in the United States. The Italian physicist Enrico Fermi directed the work. His reactor consisted of a large pile of graphite blocks and chunks of uranium metal. After Fermi's success, other physicists in the United States developed larger and more complex reactors for various purposes.

The first experimental breeder reactor was built in 1951 at the National Reactor Testing Station (now Idaho National Engineering Laboratory), near Idaho Falls, Idaho, in the United States. In 1954, the U.S. Navy launched the submarine *Nautilus,* the first ship powered by energy from a nuclear reactor. In 1955, electricity for public use was first generated from a reactor at the National Reactor Testing Station. But it was done on a very limited basis.

A team of British engineers and scientists built the world's first large-scale nuclear power plant, which began to produce electricity in 1956.

In most countries, nuclear reactors generate only a small part of the total electric energy output. Some countries rely heavily on nuclear energy. In France and Belgium for example, about 75 per cent of the electric energy is generated by nuclear reactors.

Scientists of several countries, including France, India, and the United States, have developed experimental breeder reactors. These special reactors can produce more fuel than they use to produce energy. The surplus can be used by other nuclear reactors.

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Nuclear submarine. See **Submarine.**

Nuclear waste. See **Nuclear energy** (Wastes and waste disposal).

Nuclear weapon is any weapon that gets its destructive power from the transformation of matter in atoms into energy. All nuclear weapons are explosive devices. They include missiles, bombs, artillery shells, mines, and torpedoes. The most powerful ones are far more destructive than any *conventional* (nonnuclear) weapon.

Nuclear weapons consist of *fission weapons,* also called *atomic weapons,* and *thermonuclear weapons,* which are also known as *hydrogen weapons* or *fusion weapons.* In fission weapons, matter is changed into energy when the *nuclei* (cores) of certain kinds of uranium or plutonium atoms are split. In thermonuclear weapons, matter is converted into energy when pairs of certain kinds of hydrogen nuclei combine to form a single nucleus. In general, thermonuclear weapons are much more powerful than fission weapons. Today, a large majority of nuclear weapons are thermonuclear devices.

The first nuclear weapons were two fission bombs used by the United States during World War II (1939-1945). In the war, one was dropped on each of the Japanese cities of Hiroshima and Nagasaki. Japan's surrender ended the war. The Hiroshima bomb caused the greater destruction. It killed from 70,000 to 100,000 people and destroyed approximately 13 square kilometres of the city. About 12,000 metric tons of TNT would have been required to produce the same amount of damage. Most of today's large thermonuclear weapons are about 8 to 40 times as powerful as the Hiroshima bomb.

The bombs exploded at Hiroshima and Nagasaki are the only two nuclear weapons that have ever been used. Since the end of World War II, however, nuclear weapons have dominated the military planning of the world's most powerful nations. Until 1991, two countries—the United States and the Soviet Union—had most of the world's nuclear weapons. In 1991, the Soviet Union was dissolved, and its republics became independent. Most Soviet nuclear weapons were located in the former republics of Belarus, Kazakhstan, Russia, and Ukraine. These republics agreed in 1992 that all nuclear weapons would be turned over to Russia. Other countries that possess nuclear arms include China, France, and the United Kingdom (UK). In 1993, President F. W. de Klerk of South Africa announced that his country had manufactured six nuclear fission bombs in the 1970's, but gave assurances that the weapons had been dismantled between 1990 and 1991. Several other countries may be able to build nuclear weapons.

The great destructive power of nuclear weapons has led to much disagreement about whether any nation should have them. Most experts believe that, since the end of World War II, the threat of nuclear war probably has helped keep the peace between the world's major nations. But the extensive use of large nuclear weapons in a war would cause heavy damage to many nations.

How nuclear weapons work

Fission weapons get their destructive power from the *fission* (splitting) of atomic nuclei. Only three kinds of atoms are known to be suitable for fissioning in such weapons. These atoms are of the uranium (U) isotopes U-235 and U-238 and of the plutonium (Pu) isotope Pu-239. Isotopes are different kinds of atoms of the same element. See **Isotope** (introduction).

Nuclear fission occurs when a *neutron*—a subatomic particle with no electric charge—strikes the nucleus of a uranium or plutonium atom. When the nucleus splits, a small amount of its matter is transformed into a large amount of energy. In addition, two or three additional neutrons are released. These neutrons may then split other nuclei. If this process continues, a self-sustaining *chain reaction* forms in which each split nucleus provides the means of splitting other nuclei. Such a chain reaction must occur for a fission explosion to take place.

The formation of a self-sustaining chain reaction requires a certain minimum mass of fissionable material. This mass is known as the *critical mass.* A mass too small to support a self-sustaining chain reaction is called a *subcritical mass.*

Fission weapons use either of two basic methods to create a critical mass: (1) the *gun-type method* or (2) the *implosion method.* In the gun-type method, two subcritical pieces of material are placed in a device similar to the barrel of an artillery gun. One of the pieces rests at one end of the barrel. The other is put some distance from the first piece, with a powerful conventional explosive packed behind it. The barrel is sealed at both ends. When the weapon's fuse is triggered, the conventional explosive propels the second subcritical mass at a very high speed into the first. The resulting combined mass immediately becomes *supercritical* (greater than critical), causing a rapid, self-sustaining chain reaction, and thus a nuclear explosion. The United States used a gun-type fission bomb at Hiroshima.

In the implosion method, a subcritical mass is made supercritical by compressing it into a smaller volume. The subcritical mass, which is ball-shaped, is placed in the centre of the weapon. The mass is surrounded by a spherical arrangement of conventional explosives. When the weapon's fuse is triggered, all the conventional explosives go off at the same time. The explosions compress the mass into a high-density supercritical mass. A self-sustaining chain reaction then takes place, and the explosion occurs. The United States used an implosion-type fission bomb at Nagasaki.

Thermonuclear weapons get their power from the *fusion* (combining) of atomic nuclei under intense heat. The nuclei fused in thermonuclear weapons are of the hydrogen isotopes deuterium (^{2}H) and tritium (^{3}H).

Fusion reactions require temperatures equal to, or

Nuclear weapons include missiles and artillery shells. The top photograph on the left shows the launching of two long-range nuclear missiles. Such missiles carry extremely powerful thermonuclear devices. The explosion of such a device creates a huge mushroom-shaped cloud like the one shown on the right. A self-propelled howitzer, *bottom left,* can fire nuclear artillery shells.

greater than, those found in the sun's core—about 15,000,000° C. The only practical way to achieve such temperatures is by means of a fission explosion. Thus, thermonuclear explosions are triggered by an implosion-type fission device. When the fission device explodes, it also releases neutrons that bombard a compound inside the weapon. This compound, called *lithium-6 deuteride,* consists of deuterium and lithium-6, an isotope of the element lithium. When struck by the released neutrons, the lithium-6 forms helium and tritium. Then, pairs of tritium nuclei, pairs of deuterium nuclei, and pairs of one tritium nucleus and one deuterium nucleus each fuse to form helium nuclei. A small amount of matter from each deuterium and tritium nucleus is converted into a large amount of energy, and a thermonuclear explosion occurs. The *yield* (explosive power) of a thermonuclear weapon can be increased by surrounding the lithium-6 deuteride with a blanket of the uranium isotope U-238. The U-238 undergoes fissioning in the course of the hydrogen explosion.

Effects of nuclear weapons

Nuclear explosive devices can have a wide variety of yields. Some older bombs had yields of about 20 *megatons,* or 1,540 Hiroshima bombs. A megaton is the amount of energy released by 907,000 metric tons of TNT. Today, because of the higher accuracy of missiles, most nuclear devices have yields of less than 1 megaton.

The effects that a nuclear explosion has on people, buildings, and the environment can vary greatly, depending on a number of factors. These factors include weather, terrain, the point of explosion in relation to the earth's surface, and the weapon's yield. This section describes the possible effects of a large nuclear weapon. The weapon's explosion would produce four basic effects: (1) a blast wave, (2) thermal radiation, (3) initial nuclear radiation, and (4) residual nuclear radiation.

Blast wave. The explosion begins with the formation of a *fireball,* which consists of a cloud of dust and of extremely hot gases under very high pressure. A fraction of a second after the explosion, the gases begin to expand and form a blast wave, also called a *shock wave.* This wave moves rapidly away from the fireball like a moving wall of highly compressed air. The blast wave created by a 1-megaton explosion could travel about 19 kilometres from *ground zero* in the first 50 seconds after the explosion. Ground zero is the point on the ground below the point where the explosion in the air occurs.

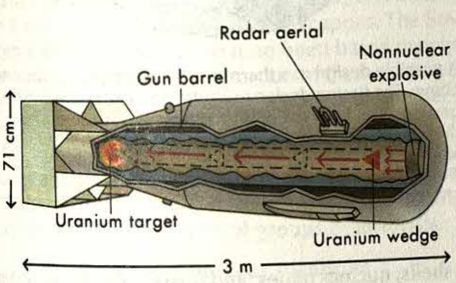
The blast wave causes most of the damage that results from the explosion. As the wave moves forward, it creates *overpressure,* which is atmospheric pressure above the normal level. A 1-megaton explosion can produce enough overpressure to destroy most buildings within 1.6 kilometres of ground zero. The overpressure from such an explosion also can cause moderate to severe damage to buildings within about 10 kilometres of ground zero. The blast wave also is accompanied by strong winds. These winds may reach speeds of 640 kilometres per hour 3.2 kilometres from ground zero. The blast wave and wind probably would kill the majority of people within 5 kilometres of ground zero and some of the people between 5 and 10 kilometres from ground zero. Many other people within 10 kilometres of ground zero would be injured.

Thermal radiation consists of ultraviolet, visible, and infrared radiation given off by the fireball. The ultraviolet radiation is rapidly absorbed by particles in the air, and so it does little harm. However, the visible and infrared radiation can cause eye injuries as well as skin burns called *flash burns.* Between 20 and 30 per cent of the deaths at Hiroshima and Nagasaki resulted from flash burns. Thermal radiation also can ignite such highly flammable materials as newspapers and dry leaves. The burning of these materials can lead to large fires. Some scientists theorize that, in a nuclear war, the smoke from such fires would absorb enough sunlight to lower the temperature of much of the earth's surface for several months or years. These scientists speculate that the lowered temperatures would result in widespread crop failure and famine. This possible effect of nuclear war is known as *nuclear winter.* However, the effects of thermal radiation can vary considerably. When a light atmospheric haze is present, for example, the effects could be only one-hundredth as strong as they would be if the air were clear.

A person can be shielded from the direct effects of thermal radiation by such solid, nontransparent objects as walls, buildings, trees, and rocks. In addition, light-coloured clothing, which reflects heat, can help protect a person from flash burns. However, thermal radiation produced by a 1-megaton explosion can produce *second-degree burns* (blistering) in exposed human skin up 18 kilometres from ground zero. The thermal radiation would last only about 10 seconds. Thus the radiation would char, but not completely burn, heavy fabrics and thick pieces of wood or plastic.

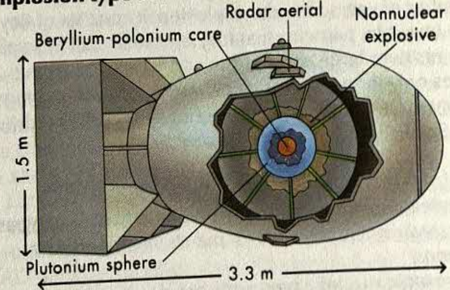
Initial nuclear radiation is given off within the first minute after the explosion. It consists of neutrons and *gamma rays* (see **Gamma rays**). The neutrons and some of the gamma rays are emitted from the fireball almost instantaneously. The rest of the gamma rays are given off by a huge mushroom-shaped cloud of radioactive material that is formed by the explosion. Nuclear radiation can cause the swelling and destruction of human cells and prevent normal cell replacement. Large doses of radiation can cause death.

Gun-type fission bomb



Hiroshima, Japan, was largely destroyed by a gun-type fission bomb called the Little Boy bomb, *top,* on Aug. 6, 1945. The bomb was dropped from a B-29 bomber. When the bomb reached 564 metres, a radar echo set off an explosive inside. This explosive drove a wedge of U-235 into a larger piece of U-235, setting off the nuclear blast. The photograph above shows Hiroshima after the explosion.

Implosion-type fission bomb



Nagasaki, Japan, was struck by an implosion-type fission bomb called the Fat Man bomb, *top,* on Aug. 9, 1945. In this bomb, an explosive crushed a hollow sphere of plutonium into a core made up of the chemical elements beryllium and polonium. This core then released neutrons, which triggered a fission chain reaction in the plutonium. The photograph above shows Nagasaki after the nuclear blast.

The amount of harm a person would suffer from initial nuclear radiation depends in part on the person's location in relation to ground zero. Initial radiation decreases rapidly in strength as it moves away from ground zero. In all nuclear explosions, for example, the initial radiation at about 0.5 to 1 kilometre from ground zero is only about one-tenth to one-hundredth as strong as the radiation at ground zero.

Residual nuclear radiation is given off later than one minute after the explosion. Residual radiation created by fission consists of gamma rays and *beta particles* (electrons). Residual radiation produced by fusion is made up primarily of neutrons. It strikes particles of rock, soil, water, and other materials that make up the mushroom-shaped cloud. As a result, these particles become radioactive. When the particles fall back to earth, they are known as *fallout.* The closer an explosion occurs to the earth's surface, the more fallout it produces.

Early fallout consists of heavier particles that reach the ground during the first 24 hours after the explosion. These particles fall mostly downwind from ground zero. Early fallout is highly radioactive and will kill or severely damage living things.

Delayed fallout reaches the ground from 24 hours to a number of years after the explosion. It consists of tiny, often invisible, particles that may eventually fall in small amounts over large areas of the earth. Delayed fallout causes only long-term radiation damage to living things. However, this damage can be serious for certain individuals. See **Fallout.**

Strategic and theatre nuclear weapons

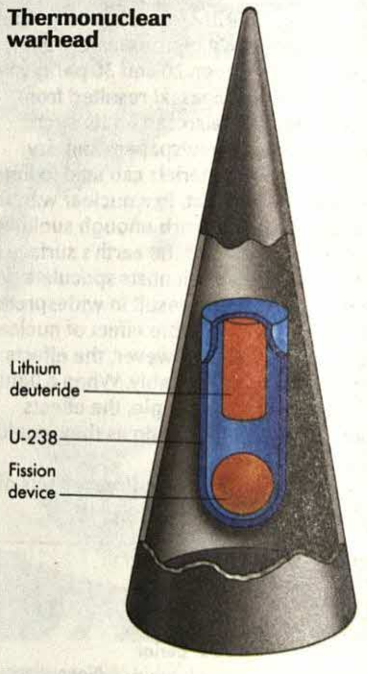
Nuclear weapons can be divided into two main types: (1) *strategic nuclear weapons* and (2) *theatre nuclear weapons.*

Strategic nuclear weapons are designed primarily to launch an attack from great distances on targets in an enemy's homeland. These weapons include bombs and missiles delivered by long-range bomber aircraft. They also include missiles that can deliver explosive devices to targets that generally are up 10,500 kilometres from the launch site. Some of these missiles are based on land. Others are based underwater on submarines. Strategic nuclear missiles include *intercontinental ballistic missiles* (ICBM's), *submarine-launched ballistic missiles* (SLBM's), and *cruise missiles* (see **Guided missile** [Ballistic missiles; Nonballistic missiles]).

Some strategic nuclear missiles have a number of nuclear *warheads,* each of which carries explosive material to a separate target. These warheads are called Multiple Independently Targetable Reentry Vehicles (MIRV's).

Strategic nuclear weapons can destroy or disable an enemy's strategic nuclear weapons. They also can disrupt an enemy's economy or social organization.

Theatre nuclear weapons are designed for use within a *military theatre,* a large geographic area in which conventional warfare is taking place. Smaller or shorter-range theatre nuclear weapons are also called *tactical nuclear weapons.* Theatre nuclear weapons can be used to attack conventional forces during a battle or military campaign, or to attack the enemy's theatre nuclear weapons. Theatre nuclear weapons include medium-range ballistic and cruise missiles. They also include short-range guided missiles and unguided rockets; artillery shells; nuclear mines; and torpedoes. Some older artillery shells are fission weapons.



A possible design of a thermonuclear warhead is shown above. The fission device explodes and produces hydrogen isotopes from the lithium deuteride. The isotopes then fuse, creating a thermonuclear explosion that fissions the U-238 and increases the warhead's power.

Nuclear weapons in military planning

The first nuclear weapons were built just as the United States and the Soviet Union were becoming the world's leading military powers. Later, tensions between the two countries led to the growth of each nation's *arsenal* (supply) of nuclear weapons. This section discusses the military reasons behind the growth and structure of both the U.S. and Soviet nuclear arsenals.

The United States. Since the mid-1930's, some U.S. military planners have considered airpower a means of ending a war quickly. Before World War II, they thought that a war could be shortened by using bombers to strike a quick, crushing blow against an aggressor's homeland. During World War II, this *airpower theory* led the United States to drop many conventional bombs on Germany and Japan. However, this did not end the war. Germany surrendered only after its army was defeated by Allied ground troops. Japan surrendered after two nuclear bombs were dropped on Hiroshima and Nagasaki.

U.S. supporters of the airpower theory thought that the successful use of nuclear bombs against Japan confirmed the theory. As a result—and because nuclear weapons are far cheaper to build and maintain than conventional forces—nuclear weapons became the main source of U.S. strategic military power.

In the mid-1950's, the United States adopted a nuclear weapons policy called *massive retaliation.* This policy stated that if Soviet forces struck any area vital to the interests of the United States and its allies, the United States might respond with a major nuclear strike against the aggressor's homeland.

In the early 1960's, the policy of massive retaliation was replaced by that of *flexible response.* According to this policy, the U.S. response to enemy aggression would begin with the use of conventional forces. Then, if these forces failed to defeat the aggressor, the United States would use theatre nuclear weapons. The United States would attack with strategic nuclear weapons only if theatre weapons failed to defeat the aggressor. In 1990, the United States announced it intended to amend its policy to one in which any kind of nuclear weapon would be used only as a last resort.

The Soviet Union. Beginning in the 1930's, Soviet military planners based their military strategy on the *deep battle theory.* Unlike U.S. planners, who have emphasized the use of airpower as a response to attack, Soviet planners long stressed the combined use of all available weapons in an early and overwhelming offensive against enemy forces. Soviet planners preferred that such an attack be a surprise. Most experts believed such a strike could include nuclear weapons. The Soviet strategic nuclear arsenal had long been based mainly on large land-based missiles. A portion of them could possibly cripple the U.S. land-based missile and bomber forces in a *first strike* (initial nuclear attack).

After the Soviet Union dissolved in late 1991, most concern about the possible use of Soviet nuclear weapons shifted from their use under a military plan to uncontrolled use by rival political groups or terrorists.

Control of nuclear weapons

Since 1945, the combined explosive power of all the world's nuclear weapons has increased enormously. Because of the great dangers associated with nuclear weapons, many attempts have been made to control them. The chief approaches to control have been strategies of deterrence and the placing of limits on the testing, numbers, and proliferation of nuclear weapons.

Deterrence refers to preventing the countries that have nuclear weapons from using them. Theories of deterrence may be offence-based or defence-based.

Offence-based deterrence theory holds that the possession of a strong nuclear force by each of two opposing nations will best prevent nuclear war between the two countries. Each force must be so large that, following a first strike, enough of the defender's weapons would be left over to deliver a devastating blow to the aggressor's homeland. The theory relies on a potential aggressor's believing that if it launched a nuclear attack, it would suffer unacceptable destruction itself. Some experts consider that neither nation should have a major defence against a nuclear strike. In 1972, the United States and the Soviet Union signed a treaty limiting each country's deployment of defensive missiles.

Other experts suggest that offence-based deterrence would be strengthened by the addition of a defensive system that would protect enough of the defender's forces for an effective nuclear counterattack.

Defence-based deterrence theory holds that only a defence against a first strike will reliably prevent a nuclear attack. This theory rests on the belief that an aggressor will not attack if it is not sure it can destroy the victim's ability to launch a nuclear counterattack. No country has a defence that would create such uncertainty. In 1983, the United States began focusing its research efforts on the Strategic Defense Initiative (SDI) programme. See **Strategic Defense Initiative.**

Limiting testing. Nations have sought to limit the testing of nuclear weapons to protect people and the environment from nuclear radiation and to slow the development of nuclear weapons. In 1963, the Soviet Union, the UK, and the United States negotiated the first—and chief—test limitation treaty, the Limited Test Ban Treaty. The treaty's signers agreed not to test nuclear weapons in the atmosphere, in outer space, or underwater. Only underground testing was not banned.

In 1974, the United States and the Soviet Union agreed not to test explosive devices with yields above 150 *kilotons.* A kiloton is the amount of energy released by 907 metric tons of TNT. The treaty that contains the agreement, called the Threshold Test Ban Treaty, was not ratified by either country. But both nations agreed to follow the treaty's guidelines.

Nonproliferation refers to efforts to prevent the spread of nuclear weapons to nations that do not have them. The main treaty designed to stop the proliferation of nuclear weapons is called the Treaty on the Non-Proliferation of Nuclear Weapons. It was approved by the United Nations in 1968 and has since been ratified by about 155 countries.

Limiting numbers. Attempts to control the number of U.S. and Soviet nuclear weapons began about 1970. Two series of talks, the Strategic Arms Limitation Talks (SALT) and the Strategic Arms Reduction Talks (START), provided the framework for U.S.-Soviet negotiations.

The SALT talks aimed at setting limits at levels then existing for some weapons and at higher levels for others. The negotiations resulted in the SALT I and SALT II agreements of 1972 and 1979. SALT-I was ratified by both nations. But the U.S. Senate refused to ratify SALT-II following the Soviet invasion of Afghanistan in 1979.

The START talks, begun in 1982, sought to reduce the total stocks of weapons held by each country. In July 1991, a START treaty to cut long-range nuclear weapons on both sides by about 30 per cent was signed by the U.S. and Soviet governments.

The succession of Mikhail Gorbachev to the Soviet leadership in 1985 brought the beginnings of a thaw in East-West relations. In 1987, Gorbachev and U.S. president Ronald Reagan signed the Intermediate-Range Nuclear Forces (INF) Treaty. This treaty called for the elimination of all Soviet and U.S. ground-launched nuclear missiles with ranges of 500 to 5,500 kilometres. The treaty took effect from June 1, 1988.

In 1989, the Communist governments of Eastern Europe collapsed. Gorbachev declined to use Soviet conventional military forces to suppress the process of liberalization. This refusal removed the Soviet threat to Western Europe and reduced the need to maintain large nuclear arsenals. In November 1990, the United States, the Soviet Union, and 20 other countries signed the Conventional Forces in Europe (CFE) treaty, effectively ending the Cold War (see **Cold War**). In late March 1991, the Warsaw Pact, the Eastern Bloc equivalent of the North Atlantic Treaty Organization, was dissolved.

In September 1991, U.S. president George Bush announced that the United States would immediately take out of service all its tactical nuclear weapons, except those carried by certain aircraft. The United States would destroy all its ground-based tactical nuclear weapons and some of those carried on ships and aircraft. Bush's announcement, which was made without prior U.S.-Soviet negotiation, brought forth a swift response from Soviet president Gorbachev. He matched Bush's measures by announcing the destruction of battlefield weapons and the standing down of hundreds of strategic missiles and long-range bombers. He also announced a stop on the production of new nuclear weapons, a one-year ban on underground nuclear testing, and a readiness to discuss with the U.S. joint systems to avert nuclear missile attacks.

The Soviet Union itself broke up at the end of 1991 and was replaced by the Commonwealth of Independent States (C.I.S.). The breakup appeared to end any immediate threat of large-scale nuclear war. The breakup also raised concerns over who would control former Soviet nuclear weapons, possible spread to terrorists or others, and the fate of arms-control agreements signed by the Soviet Union. Four of the independent states—Belarus, Kazakhstan, Russia, and Ukraine—had strategic nuclear arms at the time of the breakup. In May 1992, they and the United States signed an agreement to abide by START. Later that year, under the CFE treaty, they began to reduce their conventional weapons and force levels. Ukraine, Kazakhstan, and Belarus agreed to turn over all strategic weapons to Russia. Finally, C.I.S. members agreed that former Soviet nuclear weapons would be controlled jointly, under the authority of the C.I.S.

In January 1993, U.S. President George Bush and Russian President Boris Yeltsin signed START II, a new arms-reduction treaty that supplements START, now called START I. While START I cuts U.S. and former Soviet strategic weapons from 23,500 to 15,400, START II cuts the number to between 6,000 and 7,000. START II also eliminates land-based MIRV's. In 1994, Ukraine became the last of the former Soviet republics with nuclear weapons to ratify START I.

History

The beginnings. Scientists gained an understanding of the basic structure of the atom by the early 1900's. In 1938, researchers discovered that splitting the nucleus of a uranium atom resulted in the release of much energy. For the early history of atomic research, see **Atom** (Development of the atomic theory); **Nuclear energy** (Development of nuclear energy).

World War II. By early 1939, U.S. physicists had become aware of the potential military applications of nuclear energy. They became especially concerned that Nazi Germany might develop a nuclear weapon. World War II began on Sept. 3, 1939. The United States entered the war in December 1941. In 1942, the U.S. government set up the Manhattan Project to design and build a fission bomb.

On July 16, 1945, Manhattan Project scientists led by the American physicist J. Robert Oppenheimer exploded the first experimental nuclear device. The device, set off at the Trinity test site near Alamogordo, New Mexico, U.S.A., was a 22-kiloton implosion-type fission device.

The first nuclear weapon used by the United States against Japan was a gun-type fission bomb. It had a yield of about 13 kilotons. The bomb was dropped from a B-29 aircraft on the city of Hiroshima on Aug. 6, 1945. Three days later, another B-29 dropped a 22-kiloton implosion-type fission bomb on Nagasaki, Japan. These bombs largely destroyed both cities, but the number of deaths differed greatly. The smaller bomb killed from 70,000 to 100,000 people in Hiroshima, which has a flat terrain. The larger bomb killed about 40,000 in Nagasaki, which has a hilly terrain. Other people in both cities died later of injuries and radiation. On Aug. 14, 1945, Japan agreed to surrender, ending World War II.

The Cold War. By the late 1940's, tension between the Soviet Union and the United States led to a bitter struggle known as the Cold War. During the Cold War, many nuclear weapons were developed. See **Cold War**.

In 1949, the Soviet Union tested its first fission device in the midst of rising tension. In 1952, during the Korean War, the United States exploded the first experimental thermonuclear device. The Soviet Union set off its first weapons-grade thermonuclear device in 1955. In the mid-1950's, the Soviets built the first submarines equipped with nuclear missiles. In 1957, they test-launched the first land-based intercontinental ballistic missile (ICBM). The first U.S. ICBM became operational in 1959. Also in 1959, the United States commissioned its first submarine equipped with SLBM's. The first MIRV's were acquired in the 1970's, first by the United States and then by the Soviet Union.

During the Cold War, protests against the nuclear arms race were mounted by citizens in some Western countries. Many protesters called for a *nuclear freeze*—that is, a limiting of nuclear arsenals to then-current levels and an end to further testing, production, and deployment of nuclear weapons. In the mid-1980's, progress at the START talks weakened the protests.

Recent developments. Following the thaw in U.S.-Soviet relations, concern in Europe has shifted from fear of massive conventional attack to ensuring political—and therefore military—stability. Military analysts expect that nuclear military arsenals will be reduced in size. But most weapons specialists expect that nuclear weapons will continue to help prevent political tensions—in Europe or elsewhere—from developing into a major war.

Related articles in *World Book* include:

Air force (The world's major air forces; The nuclear age)
Army (Armies in the nuclear age)
Bomb (Nuclear bombs)
Guided missile
Hiroshima
Mine warfare (Land mines)
Nagasaki
Navy (Nuclear attack and defence)
North Atlantic Treaty Organization
Nuclear winter
Oppenheimer, J. Robert
Submarine (Nuclear submarines)
Teller, Edward
U-235
United Nations (Working for peace and security)
War (Limited war)

Outline

I. How nuclear weapons work
- A. Fission weapons
- B. Thermonuclear weapons

II. Effects of nuclear weapons

- A. Blast wave
- B. Thermal radiation
- C. Initial nuclear radiation
- D. Residual nuclear radiation

III. Strategic and theatre nuclear weapons

- A. Strategic nuclear weapons
- B. Theatre nuclear weapons

IV. Nuclear weapons in military planning

- A. The United States
- B. The Soviet Union

V. Control of nuclear weapons

- A. Deterrence
- B. Limiting testing
- C. Nonproliferation
- D. Limiting numbers

VI. History

Questions

When was the first thermonuclear device exploded?
How does nuclear radiation affect human cells?
What kind of fission bomb did the United States use at Hiroshima? At Nagasaki?
Why did nuclear weapons become the chief source of U.S. strategic military power?
What is a *subcritical mass*?
Why have nations sought to limit nuclear weapon testing?
How are the extremely high temperatures required by fusion reactions achieved?
In what ways does a fission weapon differ from a typical thermonuclear weapon?
What is a *megaton*?

Nuclear winter refers to the deadly worldwide environmental effects that could result from a major nuclear war. Such a war could bring on nuclear winter by causing disastrous changes in the earth's atmosphere and climate. Nuclear winter could begin to develop from city fires created by the extreme heat of nuclear explosions. Large amounts of smoke from these fires could spread and cover at least half the earth's surface. The smoke could prevent most sunlight from reaching the ground. Temperatures could drop substantially, and rainfall could be reduced. These conditions might last for several months or years. With greatly reduced sunlight, less rain, and lower temperatures, farming could stop, and worldwide famine could result. Nuclear winter also could reduce the earth's ozone layer, which protects people and other forms of life from the sun's dangerous ultraviolet light.

Scientists estimate that a major nuclear war could kill 500 million people. However, 4 billion more people could starve to death the following year. Thus, nuclear winter could endanger every country in the world.

Nucleic acid is a complex molecule found in all cells. The two types of nucleic acids are *deoxyribonucleic acid (DNA)* and *ribonucleic acid (RNA)*. DNA is mainly found in the nucleus of a cell. But RNA may be found throughout the cell. Even bacterial cells, which do not have a nucleus, contain DNA and RNA. Certain viruses contain only RNA and other viruses contain only DNA.

DNA plays a vital part in heredity. It is the hereditary material of an organism. Short sections of DNA called *genes* determine an organism's characteristics. Genes are located in *chromosomes,* the threadlike structures in the nucleus. When a cell divides, its chromosomes and genes are duplicated and passed on to the two resulting daughter cells.

DNA contains *phosphate,* a sugar called *deoxyribose,* and compounds called *bases.* These are arranged in units of phosphate-sugar-base—phosphate-sugar-base, repeated hundreds of thousands of times to form long, coiled chains. This fundamental chemical structure is common to all DNA. However, there are four different bases in DNA—*adenine, guanine, thymine,* and *cytosine.* The exact proportions of each of these nucleotides and the precise order in which they are arranged, are unique for each kind of living thing. It is this exact order and composition that must be faithfully copied each time a cell divides. Scientists can *synthesize* (chemically reconstruct) some kinds of DNA molecules that are able to reproduce themselves.

RNA also consists of long chains of repeating phosphate-sugar-base units. However, the sugar in RNA is *ribose* (rather than deoxyribose as in DNA) and the bases are adenine, guanine, cytosine, and *uracil* (rather than thymine). RNA is important in the formation of proteins.

Some RNA molecules, called *messenger RNA* or *mRNA,* leave the nucleus carrying instructions for making proteins. These mRNA molecules go to *ribosomes,* the cell structures where proteins are made. Proteins are chains of smaller organic molecules called *amino acids.* There are 20 kinds of amino acids involved in protein production.

Related articles. For a detailed discussion and diagrams, see **Cell** and **Heredity**. See also the following articles:

Crick, Francis H. C.
Franklin, Rosalind E.
Life (diagram: The importance of carbon in life)
Protein
Watson, James D.
Wilkins, Maurice H. F.

Nucleus. See **Amoeba; Atom; Cell; Comet; Nuclear energy; Radiation.**

Nuer are a cattle-rearing people of east-central Africa. About 460,000 Nuer live in the grasslands and swamps of the upper Nile Valley in southern Sudan and western Ethiopia. They speak a language called Nuer, which belongs to the Nilotic family of African languages. The Nuer belong to a group of black Africans called *Nilotes* and are closely related to the Dinka (see **Dinka**).

Cattle play an important role in the social and religious life of the Nuer. For example, a Nuer groom gives a gift of cattle to his bride's family. The Nuer sacrifice cattle to their supreme god and to lesser spirits. Milk and milk products are important in their diet, but the Nuer do not kill cattle for meat.

The Nuer drive their herds to pastures along the Nile and its tributaries during the dry season, from January to May. During the rainy season, from May to December, the Nile floods its valley, and the Nuer move to higher ground. There they grow peanuts, a grain called *millet,* and other crops. The Nuer build houses of sun-dried mud and make thatched roofs for the dwellings.

Nuer boys are initiated into manhood when they are between 12 and 16 years old. During the initiation ceremony, an older man makes six deep cuts with a knife across the forehead of each youth to signify maturity.

The Nuer are divided into clans whose members have a common ancestor. Each clan has its own pastures and water sources. Until the 1900's, the Nuer were not organized under the control of leaders. A religious expert called the *kuuarmuon* or *leopard-skin chief* helped settle disputes and presided at religious ceremonies. However, he had little political authority.

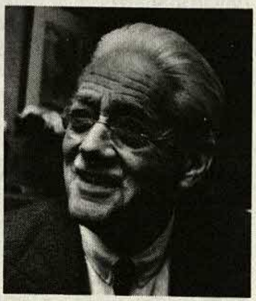
Great Britain and Egypt made the Sudan a protectorate in 1899 and brought many changes to the Nuer. For example, the Nuer began to appoint chiefs to serve as leaders. However, the people still herd cattle and practise their traditional religion.

Nuevo Laredo (pop. 218,413), is a city on the eastern part of Mexico's border with the United States. For location, see **Mexico** (political map). A major international bridge across the Rio Grande links the city with Laredo, Texas, just north of the border.

Nuevo Laredo is a major point of entry into Mexico. It lies at the northern end of one of the stretches of the Pan American Highway, the principal road to Mexico City. Each year, millions of tourists from the United States visit Nuevo Laredo. They shop in the city's handicraft stores; attend bullfights, dog races, and horse races; and fish in a large lake nearby.

The city of Laredo was founded in 1755. It then included what are now Laredo and Nuevo Laredo. Laredo and Nuevo Laredo became separate cities in 1848, when the Treaty of Guadalupe Hidalgo established the boundary between Mexico and Texas. *Nuevo* in the name Nuevo Laredo means *new.*

Nuffield, Lord (1877-1963), William Richard Morris, pioneered motorcar manufacturing. He made his first motorcar in 1911. He began mass-producing cars in the United Kingdom after World War I and, by 1926, his firm was making 100,000 cars a year. A philanthropist, Nuffield gave 1 million pounds and a site to Oxford University for Nuffield College. In 1943, he established the Nuffield Foundation for educational, medical, scientific, and social research with a gift of 10 million pounds. Nuffield was born in Worcester, England. He was made a baronet in 1929 and became Lord Nuffield in 1934.



Lord Nuffield

Nulla nulla is an Australian Aboriginal word for *club,* probably derived from one of the Sydney district dialects. The Aborigines had a variety of clubs for hunting and fighting. Most of them were of wood with pointed, rounded, or knobbed heads and handles about a metre long, but in some cases, stone heads were attached. Nulla nullas were often thrown at game or enemies.

Nullarbor Plain is a dry limestone plateau in Western Australia and southwestern South Australia. It is an almost featureless area with no surface streams. It has an average annual rainfall of less than 254 millimetres. Any rain that falls on the plain disappears quickly through the limestone.

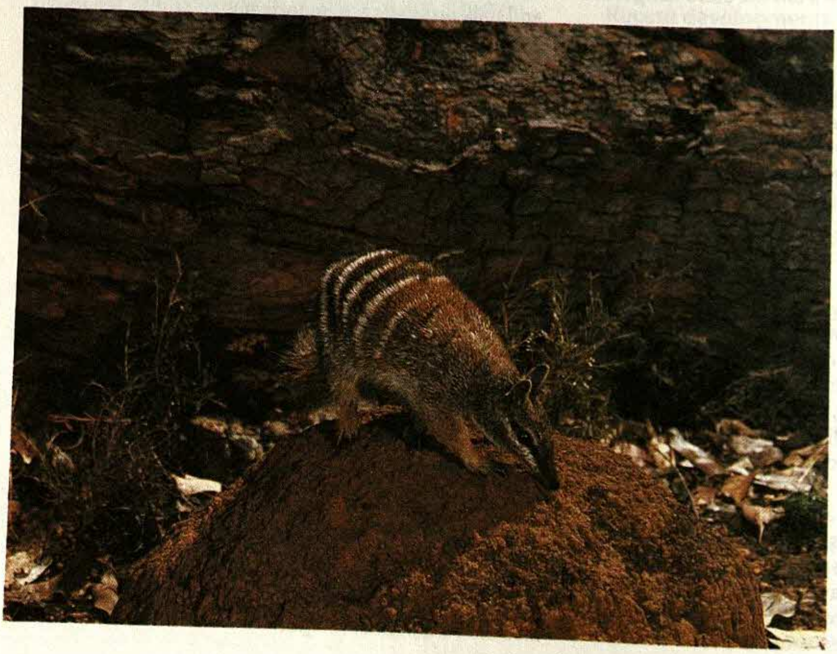
Bluebushes and saltbushes are the only shrubs that grow. Few people live on the plain. But small settlements stand at Eucla and along the Eyre Highway.

Numbat is an Australian marsupial, the size of a large rat. It has striking banded coloration and a bushy tail. The numbat is rusty-red above and white below. The hind third of the back is crossed by about six white bands; a black stripe runs through the eye from snout to ear. Females do not have the characteristic marsupial pouch.

Numbats feed during the day mainly on termites, which they catch by scratching open the insect's underground tunnels. The termites are caught on the numbat's long, sticky, cylindrical tongue. Numbats live in scrub woodland. They shelter at night in hollow logs. The numbat was once common over much of the southern half of Australia but is now found only in the southwest corner.

Scientific classification. The numbat belongs to the family Myrmecobiidae. It is *Myrmecobius fasciatus.*

Number, in grammar, is a feature of language that indicates how many people or objects are referred to. In English, the form of a noun shows whether the reference is to one person, place, object, or idea, or to more than one. The form that indicates only one is called the



A numbat searches for termites on top of a termite mound. The numbat is a marsupial found only in the southwestern corner of Australia.

singular. The form that indicates more than one is called the *plural.* Some other languages have a singular form, indicating one; a *dual* form, indicating two; and a plural form, indicating more than two. The plurals of English nouns are formed in *regular* and *irregular* ways.

Regular plurals are formed by adding *-s* or *-es* to the singular forms of the noun, as in *cap, caps* and *church, churches.* Compound nouns form plurals with the addition of *-s* or *-es,* but the placement varies. For example, the plural of *brother-in-law* is *brothers-in-law.* But the plural of *grown-up* is *grown-ups.* And in *manservant,* both parts take the plural form—*menservants.*

Irregular plurals are not formed according to any established rule, as are regular plurals. The plurals of some nouns of Old English origin are formed by a vowel change, as in *man, men* and *tooth, teeth.* A small number of nouns still have the Old English plural ending *-en*—for example, *ox, oxen* and *child, children.*

About a dozen nouns that end in *-f* or *-fe* are changed to *-ves* in the plural, among them *half, halves* and *wife, wives.* But not all nouns that end in *-f* or *-fe* follow this pattern. For example, *roof* and *chief* form regular plurals —*roofs* and *chiefs.*

Some nouns, such as *barracks, deer,* and *sheep,* have the same form in both the singular and the plural. A few expressions use a singular form even though a plural is actually called for. These include *two-centimetre nail,* and *ten-litre bucket.*

Some nouns, including *cowardice* and *brilliance,* have no plural. They differ from such nouns as *deer* and *sheep* because *two sheep* is correct, but *two cowardices* is not. The plural of *cowardice* would usually be expressed by saying something like *There are different kinds of cowardice.*

Foreign plurals. Words coming into English from foreign languages sometimes keep their foreign plurals. Such foreign plurals are mostly from Greek and Latin words. Some of these are *phenomenon, phenomena; criterion, criteria; fungus, fungi;* and *thesis, theses.* There is a strong tendency for such words to go into the regular English plural group. For example, at an earlier period the plural of *stadium* was the foreign form *stadia.* Now, however, *stadiums* is the plural form often used.

The spelling of plurals in English has many irregularities that are not reflected in speech. Singular nouns that end in *-y,* following a consonant, are changed to *-ies* in the plural—for example, *lady, ladies; flurry, flurries;* and *party, parties.* For those ending in *-y,* preceded by a vowel, *-s* is added, as in *alley, alleys* and *day, days.* Some nouns that end in *-o* have *-s* added: *Eskimos* and *pianos.* Others, for no special reason, have *-es* added: *tomatoes* and *heroes.* Several even have optional forms, such as *zeroes* or *zeros* and *ghettoes* or *ghettos.*

English pronouns also have plurals, but the relationship is not so consistent as in nouns. *We* can be called the plural of *I,* and *they* the plural of *he, she,* and *it. These* is the plural of *this,* and *those* the plural of *that.*

English verbs reflect number by agreeing with the subject. For example, the verb *play* occurs with a plural subject in the sentence *The boys play football every day.* The verb appears with a singular subject in *The boy plays football every day.*

See also **Declension; Inflection; Noun** (Number and case); **Pronoun; Verb.**

Number and numeral. A number is an idea that is used to refer to amounts of things. People use *number words, number gestures,* and *number symbols.* Number words are said out loud. Number gestures are made with some part of the body, usually the hands. Number symbols are marked or written down. A number symbol is called a numeral. When we read a numeral out loud, we say the number word for that numeral. When we want to write a number, we can write the numeral or the word. For example, we say the word *five* and write the numeral *5* or the word *five.* The number is the idea we think of when we see the numeral or when we see or hear the word.

There are several kinds of numbers. *Cardinal numbers* tell how many things there are, as in "There are *five* people in my family." *Ordinal numbers* tell the position of something in an ordered set. For example, "I am *sixth* in the queue for lunch." *Denominate numbers* tell how many units of something there are, as in "I weigh *32* kilograms."

See also **Numeration systems; Decimal system; Arabic numerals; Duodecimal numerals; Infinity.**

Number theory is the branch of mathematics concerned with the properties of the natural numbers, 1, 2, 3, 4. . . . Mathematicians usually divide these properties into those that deal with multiplication and those that deal with addition.

Statements called *theorems* are used to describe the properties of natural numbers. The *fundamental theorem of arithmetic* is the most famous property of natural numbers dealing with multiplication. It states that every natural number can be expressed as a product of *prime numbers* in exactly one way. A prime number is a natural number that can be divided without a remainder only by itself and by 1. The Greek mathematician Euclid, who lived about 300 B.C., proved that the number of prime numbers is infinite.

The *four square theorem* describes a property of natural numbers dealing with addition. It states that every natural number can be written as the sum of four or fewer square numbers. The four square theorem was proved by the French mathematician Joseph Louis Lagrange in 1770.

Numbers, Book of, is the fourth book of the Bible. Its title, which comes from ancient Greek and Latin versions of the Bible, reflects parts of the book that describe the census, or *numbering,* of the Twelve Tribes of Israel. The Hebrew title *In the Wilderness* is perhaps more accurate because the book tells about the Israelites during their traditional 40 years of wandering in the wilderness after their departure from Egypt.

The Book of Numbers begins at Mount Sinai with God ordering the Israelite leader Moses to take a census of the Israelites. The book ends with the Israelites camped on the plains of Moab, an area east of the River Jordan, just before they entered Canaan. The book highlights the personal virtue of Moses as the leader of the difficult and rebellious Israelites. An assortment of religious material is interwoven with the main story, including stories that describe the priestly role of the Levites—one of the Twelve Tribes of Israel. Other passages give procedures for such religious rituals as purification rites and sacrificial offerings to God. See also **Pentateuch.**

Numeral. See **Number and numeral.**

Numeration systems are ways of counting and of naming numbers. They are also called *numeral systems.* We cannot see or touch numbers, because they are ideas. But we can use symbols to stand for numbers. These symbols are called *numerals.* Here are four numerals that represent the number in a half dozen: 6, six, VI, and 𝍸 I.

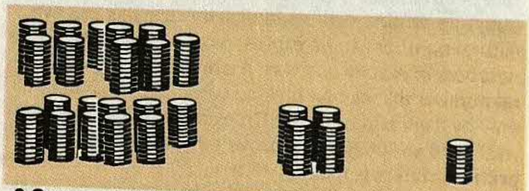
Our numeration system has only 10 basic numerals, called *digits:* 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. With these 10 symbols we can represent any number. This system is called a *decimal* system because it is based on 10. The word decimal comes from the Latin word for *ten.* Ten is the *base* or the *scale* of the decimal system.

Kinds of numeration systems

It is possible to use any whole number greater than one as a base in building a numeration system. The number of digits used is always equal to the base. For example, (1) the *decimal,* or *base 10,* system uses 10 digits; (2) the *binary,* or *base 2,* system uses 2 digits; and (3) the *hexadecimal,* or *base 16,* system uses 16 digits.

The decimal system represents numbers in terms of groups of ten. Suppose you wanted to count the pennies you have saved. Instead of counting them one by one, you could count them in groups of 10. You would put them in stacks of 10. Then you would arrange the stacks in groups, putting 10 in each group, as shown.

How many pennies are there? You could count them like this: 2 groups of 10 stacks of 10 = 2 × (10 × 10) = 200; 4 stacks of 10 = 4 × 10 = 40; plus 8 single pennies. In all, you have 200 + 40 + 8 = 248 pennies.


2 Groups of 10 Stacks of 10 Pennies
4 Stacks of 10 Pennies
8 Pennies

If you had counted the pennies one by one, you would have counted the same total. In decimal counting, you use one-digit numerals to count from 1 to 9. Then you use two-digit numerals to count from 10 to 99. In two-digit numerals, the digit on the left stands for the number of groups of ten. The digit on the right shows the number of ones. For example, the numeral 14 stands for 1 group of ten plus 4 ones. After 99, you use three-digit numerals. The first digit on the left of these numerals stands for the number of *hundreds* (groups of ten tens). Thus, the numeral 248 stands for 2 hundreds + 4 tens + 8, as shown in the illustration.

The value of each digit in a decimal numeral depends on its *place* (position) in the numeral. For example, the numeral 482 contains the same digits as the numeral 248. But 482 represents a different number because the digits are in different positions.

Each position has a name that tells its value in terms of 10. In the numeral 248, the 8 is in the *ones* place; the 4 is in the *tens* place; and the 2 is in the *hundreds* place. In numerals with more than three digits, the additional positions are called the *thousands* place, the *ten thousands* place, and so on. Each position has a value 10 times greater than the position to its right.

Another way of expressing place value is to use *powers of 10* (10 multiplied by itself a certain number of times). The following table shows the meaning of several powers of 10.

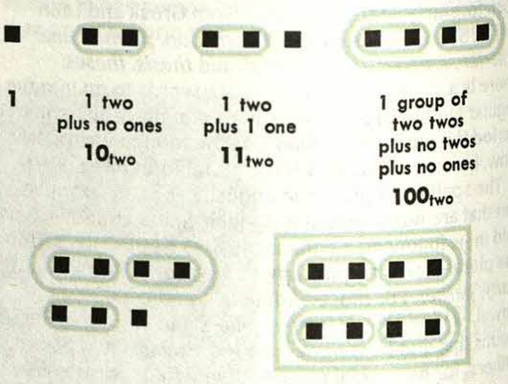
Place name	**Power of 10**	**Meaning**	**Symbol**
Ones		1	10^0
Tens	1st	1 × 10	10^1
Hundreds	2nd	10 × 10	10^2
Thousands	3rd	10 × 10 × 10	10^3
Ten thousands	4th	10 × 10 × 10 × 10	10^4

The 2 in 10^2, the 3 in 10^3, and the 4 in 10^4 are called *exponents.* The 10 is called the *base.* The exponent tells the number of times the base is to be used as a *factor.* For example, 10^2 means 10 is used as a factor twice, or 10 × 10; and 10^4 means 10 × 10 × 10 × 10. We can write the numeral 248 as 200 + 40 + 8, or we can write it as $(2 \times 10^2) + (4 \times 10^1) + 8$.

The value of any numeral is the sum of the values of the digits. The numeral 4,206 means "4 thousands plus 2 hundreds plus no tens plus 6 ones," or $(4 \times 10^3) + (2 \times 10^2) + (0 \times 10^1) + (6 \times 1)$. We could also write 4,206 as $(4 \times 10^3) + (2 \times 10^2) + (0 \times 10^1) + (6 \times 10^0)$. The exponent zero means ten is not used as a factor. 6×10^0 is another expression for 6 × 1.

The binary system groups numbers by twos and by powers of two. The word *binary* comes from a Latin word meaning *two at a time.* This system uses only two digits: 0 and 1. The numeral 10_{two} (one, zero, base two) stands for *two,* the base of the system. It means "1 two plus no ones."

Grouping by twos. The groups of squares below show the meaning of several binary numerals:


1
1 two plus no ones
10_{two}
1 two plus 1 one
11_{two}
1 group of two twos plus no twos plus no ones
100_{two}
1 group of two twos plus 1 two plus 1 one
111_{two}
1 group of two groups of two twos plus no groups of two twos plus no twos plus no ones
1000_{two}

In binary counting, single digits are used for *none* and *one.* Two-digit numerals are used for 10_{two} and 11_{two} (2 and 3 in decimal numerals). For the next counting number, 100_{two} (4 in decimal numerals), three digits are necessary. After 111_{two} (7 in decimal numerals), four-digit numerals are used until 1111_{two} (15 in decimal numerals) is reached, and so on.

Finding place value in base 2. In a binary numeral, every position has a value 2 times the value of the position to its right. For example, in the numeral 1010_{two}, the 0 on the right means 0×1; the 1 at the left of this 0 means 1×2; the next 0 means $0 \times 2 \times 2$; and the 1 at the far left of the numeral means $1 \times 2 \times 2 \times 2$.

The place value of each position can be expressed in terms of powers of 2. The following table shows the meaning of several powers of 2.

Base 2 numeral	Meaning	Decimal numerals	
1_{two}	$= 1$	$= 1$	$= 2^0$
10_{two}	$= 2 \times 1$	$= 2$	$= 2^1$
100_{two}	$= 2 \times 2$	$= 4$	$= 2^2$
$1{,}000_{two}$	$= 2 \times 2 \times 2$	$= 8$	$= 2^3$
$10{,}000_{two}$	$= 2 \times 2 \times 2 \times 2$	$= 16$	$= 2^4$

In the numeral 1010_{two}, the 0 at the right is in the ones place; the 1 next to it is in the 2^1 place; the next 0 to the left is in the 2^2 place; and the 1 at the far left is in the 2^3 place.

Binary numerals may be changed to decimal numerals by adding up the place values of the digits in terms of decimal numerals. The following calculation shows how to change the binary numeral 1101 to the decimal numeral 13:

1101_{two}

$\rightarrow 1\times1 = 1$

$\rightarrow 0\times2^1 = 0 \quad (0\times2)$

$\rightarrow 1\times2^2 = 4 \quad (1\times4)$

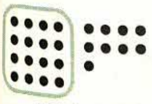
$\rightarrow 1\times2^3 = \underline{8} \quad (1\times8)$

13 base ten

The hexadecimal system groups numbers by sixteens and powers of sixteen. The word *hexadecimal* comes from the Greek word meaning *six* and the Latin word meaning *ten.* People who give directions to computers through a system of words and symbols called *assembly language* often use the hexadecimal system. It is easy to change numerals in the hexadecimal system into the binary system, the language computers actually use.

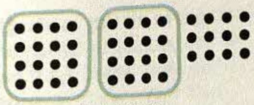
The 16 digits used in the hexadecimal system are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. A, B, C, D, E, and F stand for 10, 11, 12, 13, 14, and 15. The base 16 itself is written as $10_{sixteen}$ (one, zero, base sixteen), which means "1 sixteen plus no ones."

Grouping by sixteens. The following groups of dots show the meaning of some two-digit hexadecimal numerals.



1 sixteen plus 9 ones

$19_{sixteen}$



2 sixteens plus C (12) ones

$2C_{sixteen}$

Finding place value in base 16. In a hexadecimal numeral, as in a decimal or a binary numeral, the last digit on the right is in the ones place. Every other position has a value 16 times the value of the position to its right. For example, in the numeral $5A7_{sixteen}$, 7 means 7×1; A means $A \times 16$; and 5 means $5 \times 16 \times 16$.

The following table shows the place value of several positions in terms of powers of 16.

Base 16 numeral	Meaning	Decimal numerals	
$1_{sixteen}$	$= 1$	$= 1$	$= 16^0$
$10_{sixteen}$	$= 1 \times 16$	$= 16$	$= 16^1$
$100_{sixteen}$	$= 1 \times 16 \times 16$	$= 256$	$= 16^2$
$1{,}000_{sixteen}$	$= 1 \times 16 \times 16 \times 16$	$= 4{,}096$	$= 16^3$
$10{,}000_{sixteen}$	$= 1 \times 16 \times 16 \times 16 \times 16$	$= 65{,}536$	$= 16^4$

To change hexadecimal numerals to decimal numerals, add the place values of the digits in terms of decimal numerals. The calculation below changes the hexadecimal numeral B0E5 to the decimal numeral 45,285.

$B0E5_{sixteen}$

$\rightarrow 5\times1 = 5$

$\rightarrow E\times16 = 224 \quad (14\times16)$

$\rightarrow 0\times16\times16 = 0 \quad (0\times256)$

$\rightarrow B\times16\times16\times16 = \underline{45{,}056} \quad (11\times4{,}096)$

45,285 base ten

Changing binary numerals to hexadecimal numerals. Binary numerals use many digits to represent the same number represented by a few digits in a larger base.

Binary numerals can be changed to hexadecimal numerals by following three steps: (1) Starting at the right, underline the binary digits in blocks of four; (2) change each four-digit binary numeral to a decimal numeral; and (3) replace the decimal numerals larger than nine with the proper hexadecimal digits (A through F). The following calculation shows how to change the binary numeral 10110101 to the hexadecimal numeral B5:

$\underline{1011}$

$1\times8 + 0\times4 + 1\times2 + 1$

$8 + 0 + 2 + 1$

11

B

$\underline{0101}$

$0\times8 + 1\times4 + 0\times2 + 1$

$0 + 4 + 0 + 1$

5

5

$B5_{sixteen}$

You can change a hexadecimal numeral, such as A0E5, to a binary numeral, 1010000011100101, by reversing the three steps, as shown below:

$A0E5_{sixteen}$

$\rightarrow 10 = 1\times8 + 0\times4 + 1\times2 + 0\times1 = \underline{1010}$

$\rightarrow 0 = 0\times8 + 0\times4 + 0\times2 + 0\times1 = \underline{0000}$

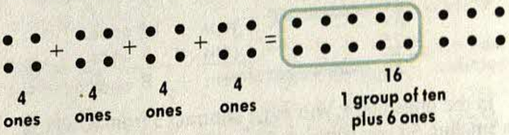
$\rightarrow 14 = 1\times8 + 1\times4 + 1\times2 + 0\times1 = \underline{1110}$

$\rightarrow 5 = 0\times8 + 1\times4 + 0\times2 + 1\times1 = \underline{0101}$

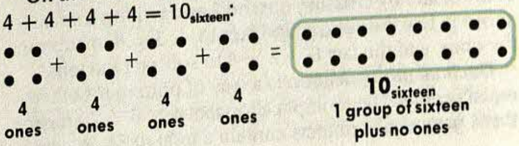
1010000011100101_{two}

Working with numeration systems

Suppose you are asked to solve an addition problem: $4 + 4 + 4 + 4 = ?$. If you use the base 10 system, the answer is 16, as shown by these groups of dots:



On the other hand, if you use the base 16 system, $4 + 4 + 4 + 4 = 10_{sixteen}$:



The numerals differ in each answer, but the number of dots is the same. The numerals are formed according to the principles of grouping and place value. Subtraction, multiplication, and division also follow these principles. You can study them by working problems in various numeration systems, and thus gain a better understanding of the use of numerals in arithmetic.

Decimal arithmetic. Statements such as $4 + 5 = 9$, $9 - 4 = 5$, $9 \times 5 = 45$, and $45 \div 9 = 5$ are called *arithmetic facts.* We use many such facts in addition, subtraction, multiplication, and division.

Decimal addition is a way of combining two or more groups into only one group. The principle of place value is used in adding ones to ones, tens to tens, and so on, as in the following example:

$$\begin{array}{r c l} 24 & \longrightarrow & 2\text{ tens} + 4\text{ ones} \\ +12 & \longrightarrow & 1\text{ ten} + 2\text{ ones} \\ \hline 36 & \longleftarrow & 3\text{ tens} + 6\text{ ones} \end{array}$$

In this example, you use the addition fact $4 + 2 = 6$ and the fact $2 + 1 = 3$ (meaning 2 tens + 1 ten = 3 tens, or 30). Therefore, the sum is 3 tens plus 6, or 36. In some problems, the sum in one or more places is 10 or more. Then you must *regroup* the sum. Regrouping in addition is sometimes called *carrying.* The next problem shows how to regroup in decimal addition.

$$\begin{array}{r c l} \overset{1}{4}8 & \longrightarrow & 4\text{ tens} + 8\text{ ones} \\ +25 & \longrightarrow & 2\text{ tens} + 5\text{ ones} \\ \hline 73 & \longleftarrow & 6\text{ tens} + 13\text{ ones} \\ & & \textit{or, after regrouping,} \\ & & 7\text{ tens} + 3\text{ ones} \end{array}$$

In this problem, the ones add up to 13, which can be regrouped into 1 ten plus 3 ones. So you write 3 in the ones place and a small 1 in the tens place above the 4. Then you add the tens: $1 + 4 + 2 = 7$ tens, or 70. Therefore, the sum is $70 + 3$, or 73.

Decimal subtraction is a way of "undoing" addition. It follows the same principles as decimal addition:

$$\begin{array}{r c l} 65 & \longrightarrow & 6\text{ tens} + 5\text{ ones} \\ -23 & \longrightarrow & 2\text{ tens} + 3\text{ ones} \\ \hline 42 & \longleftarrow & 4\text{ tens} + 2\text{ ones} \end{array}$$

In this example, you use the subtraction fact $5 - 3 = 2$, and the fact $6 - 2 = 4$ (meaning 6 tens − 2 tens = 4 tens). To subtract a large number from a smaller number in any place, you have to regroup. Regrouping in subtraction is sometimes called *borrowing.* The next example shows how to regroup in decimal subtraction.

$$\begin{array}{r c l} \overset{6}{\cancel{7}}{}^{1}3 & \longrightarrow & 6\text{ tens} + 13\text{ ones} \\ -25 & \longrightarrow & 2\text{ tens} + 5\text{ ones} \\ \hline 48 & \longleftarrow & 4\text{ tens} + 8\text{ ones} \end{array}$$

In the ones place, you must subtract 5 from 3, which is smaller. So you regroup 7 tens plus 3 ones to make 6 tens plus 13 ones. Show this by writing a small 1 in front of the 3, and by crossing out the 7 and writing a small 6 above it. Use the subtraction fact $13 - 5 = 8$ to subtract the ones, and the fact $6 - 2 = 4$ to subtract the tens.

Decimal multiplication is a way of putting together equal groups. The multiplication fact $4 \times 6 = 24$ means that 4 groups of 6 objects contain a total of 24 objects. Here is the way you use place value to multiply 23 by 3:

$$\begin{array}{r c l} 23 & \longrightarrow & 2\text{ tens} + 3\text{ ones} \\ \times 3 & \longrightarrow & 3\text{ ones} \\ \hline 69 & \longleftarrow & 6\text{ tens} + 9\text{ ones} \end{array}$$

First, think: "3×3 ones = 9 ones, and 3×2 tens = 6 tens, or 60." Then add $60 + 9 = 69$.

In multiplication, you regroup when the product in any place is 10 or more:

$$\begin{array}{r c l} \overset{1}{4}9 & \longrightarrow & 4\text{ tens} + 9\text{ ones} \\ \times 2 & \longrightarrow & 2\text{ ones} \\ \hline 98 & \longleftarrow & 8\text{ tens} + 18\text{ ones} \\ & & \textit{or, after regrouping,} \\ & & 9\text{ tens} + 8\text{ ones} \end{array}$$

In this problem, the product of 2×9 is 18, which can be regrouped into 1 ten plus 8 ones. So you write 8 in the ones place and a little 1 in the tens place above the 4. Next, multiply $2 \times 4 = 8$ in the tens place, and add the 1 to make 9.

When the multiplier has more than one digit, you repeat the operation for each digit and then add the products:

$$\begin{array}{r c l} 24 & \longrightarrow & 2\text{ tens} + 4\text{ ones} \\ \times 12 & \longrightarrow & 1\text{ ten} + 2\text{ ones} \\ \hline 48 & \longrightarrow & 4\text{ tens} + 8\text{ ones} \\ 24 & \longrightarrow & 2\text{ hundreds} + 4\text{ tens} \\ \hline 288 & \longleftarrow & 2\text{ hundreds} + 8\text{ tens} + 8\text{ ones} \end{array}$$

First, multiply 24 by 2, writing 8 in the ones place, and 4 in the tens place. Then multiply 24 by 1 ten, writing 4 in the tens place and 2 in the hundreds place. Then add the products to get 288.

Decimal division is a way of "undoing" multiplication. It is a splitting apart of one group into several groups of equal size. Here is the way you divide 69 by 3:

$$\begin{array}{r} 23 \\ 3\overline{)69} \\ \underline{6} \\ 9 \\ \underline{9} \end{array} \qquad \begin{array}{r} 2\text{ tens} + 3\text{ ones} \\ 3\text{ ones}\overline{)6\text{ tens} + 9\text{ ones}} \\ \underline{6\text{ tens}\phantom{ + 9\text{ ones}}} \\ 9\text{ ones} \\ \underline{9\text{ ones}} \end{array}$$

First, think: "6 tens ÷ 3 = 2 tens." Write 2 in the tens place above the 6. Then think: "9 ones ÷ 3 = 3 ones." Write 3 in the ones place above the 9. Therefore, $69 \div 3$ = 2 tens + 3 ones, or 23.

The principle of place value also makes it easy to divide larger numbers:

$$\begin{array}{r} 82 \\ 2\overline{)164} \\ \underline{16} \\ 4 \\ \underline{4} \end{array}$$

First, think: "16 tens ÷ 2 = 8 tens." Write 8 in the tens place above the 6. Then think: "4 ones ÷ 2 = 2 ones." Write 2 in the ones place above the 4. Therefore, $164 \div 2$ = 8 tens + 2 ones, or 82.

Binary arithmetic has only a few facts because it uses only two digits—0 and 1.

Binary addition is based on only these facts:

$0 + 0 = 0 \qquad 0 + 1 = 1 \qquad 1 + 0 = 1 \qquad 1 + 1 = 10$

Here is the way you use these facts to add 11 + 11:

Binary addition	**Meaning**	**Decimal addition**
1		
11	1 two + 1 one	3
+11	1 two + 1 one	+3
110	10 twos + 10 ones	6
	or, after regrouping,	
	1 four + 1 two + 0 ones	

First, you use the addition fact 1 + 1 = 10 (meaning 1 two) to add the ones. Regroup 10_{two} into 1 two plus no ones. Write 0 in the ones place, and a small 1 above the twos column. Then add the twos: 1 + 1 = 10; 10 + 1 = 11. Write 1 in the twos place, and 1 in the fours place. Thus, $11_{two} + 11_{two} = 110_{two}$.

Binary subtraction is based on four facts:

0 − 0 = 0　　1 − 0 = 1　　1 − 1 = 0　　10 − 1 = 1

Use these facts to subtract 11 from 110:

Binary subtraction	**Meaning** *(after regrouping twice)*	**Decimal subtraction**
110	0 fours + 10 twos + 10 ones	6
−11	1 two + 1 one	−3
11	1 two + 1 one	3

In the ones place, you have to subtract 1 from 0. So you regroup 1 four plus 1 two plus no ones into 1 four plus no twos plus 10 ones. Then use the fact 10 − 1 = 1 to subtract the ones. To subtract the twos, you again have to take 1 from 0 because your first regrouping has left a 0 in the twos place. You regroup 1 four plus no twos into no fours plus 10 twos, and use the fact 10 − 1 = 1.

Binary multiplication uses the following facts:

0 × 0 = 0　　0 × 1 = 0　　1 × 0 = 0　　1 × 1 = 1

The product of two single digits is always either 0 or 1. However, you may have to regroup when adding products to complete a multiplication problem. For example, here is the way you multiply 11 × 11:

Binary multiplication	**Meaning**	**Decimal multiplication**
11	1 two + 1 one	3
×11	1 two + 1 one	×3
11	1 two + 1 one	9
11	1 four + 1 two	
1001	1 four + 10 twos + 1 one	
	or, after regrouping,	
	1 eight + 0 fours + 0 twos + 1 one	

Multiply and write the products as you do in the decimal system. When you add the partial products, use binary addition facts. Bring down the 1 in the ones place. Add the twos: 1 + 1 = 10. Regroup 10 twos to 1 four plus no twos. Write 0 in the twos place and add 1 to the 1 in the fours place: 1 + 1 = 10. Write 0 in the fours place and 1 in the eights place to get 1001.

Binary division "undoes" binary multiplication. This example shows division with a two-digit binary numeral:

$$\begin{array}{r} 11 \\ 11\overline{)1001} \\ \underline{11} \\ 11 \\ \underline{11} \end{array}$$

To divide 11 into 1001, think, "11 is larger than 10, but smaller than 100. So it must go into 100 once." Write 1 over the second zero. Then complete the problem by multiplying and subtracting as in a decimal numeral problem. But remember to use the binary subtraction facts.

Hexadecimal arithmetic has more facts than decimal arithmetic because it uses more digits—0 through 9 plus A through F.

Hexadecimal addition. You can use the following table to find the basic facts of hexadecimal addition.

+	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

To find the sum of 6 + A, for example, first find the row that begins with 6. Then run your finger to the right along this row until you come to the column that has A at the top. Your finger will be on the 10 (meaning 1 sixteen plus no ones), the sum of 6 plus A.

Use the table to solve the following problem.

Hexadecimal addition	**Meaning**	**Decimal addition**
2C	2 sixteens + C ones	44
+81	8 sixteens + 1 one	+129
AD	A sixteens + D ones	173

First, use the fact C + 1 = D to add the ones. Then use the fact 2 + 8 = A (2 sixteens + 8 sixteens = A sixteens).

When the sum in any place is greater than F, regroup in terms of the base, 16, as shown in the next example.

Hexadecimal addition	**Meaning**	**Decimal addition**
1		
6E	6 sixteens + E ones	110
+34	3 sixteens + 4 ones	+52
A2	9 sixteens + 12 ones	162
	or, after regrouping,	
	(9 + 1) sixteens + 2 ones	
	A sixteens + 2 ones	

In the ones place, E + 4 = 12, as shown in the table. Regroup 12 ones into 1 sixteen plus 2 ones. Write 2 in the ones place and a small 1 in the sixteens place over the 6.

Then add the sixteens: 6 + 3 = 9 sixteens; 9 sixteens plus the 1 sixteen you got by regrouping equals A sixteens.

Hexadecimal subtraction. You can use the hexadecimal addition facts table to find subtraction facts, too. For example, to subtract D from 12, first find the column that begins with D. Next, run your finger down this column until you come to 12. Then run your finger to the left along this row to the first digit to find the answer, 5.

Use the table to solve the next problem in hexadecimal subtraction.

Hexadecimal subtraction	**Meaning**	**Decimal subtraction**
E8	E sixteens + 8 ones	232
−B6	B sixteens + 6 ones	−182
32	3 sixteens + 2 ones	50

Subtract the ones using the fact 8 − 6 = 2. In the sixteens place, use E − B = 3.

If the digit you wish to subtract is larger than the digit above it, you will need to regroup, as shown in the next example.

Hexadecimal subtraction	**Meaning** *(after regrouping)*	**Decimal subtraction**
$^{2}\cancel{3}\,^{1}4$	2 sixteens + 14 ones	52
−1C	1 sixteen + C ones	−28
18	1 sixteen + 8 ones	24

In the ones place, C is larger than 4. So you regroup 3 sixteens plus 4 ones as 2 sixteens plus 14 ones. Cross out the 3, write a small 2 above it, and write a small 1 in front of the 4. Then use the subtraction fact 14 − C = 8 to subtract the ones. Use the fact 2 − 1 = 1 to subtract the sixteens.

Hexadecimal multiplication also uses more facts than decimal multiplication. You can use the following table to find the basic hexadecimal multiplication facts.

x	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2	2	4	6	8	A	C	E	10	12	14	16	18	1A	1C	1E
3	3	6	9	C	F	12	15	18	1B	1E	21	24	27	2A	2D
4	4	8	C	10	14	18	1C	20	24	28	2C	30	34	38	3C
5	5	A	F	14	19	1E	23	28	2D	32	37	3C	41	46	4B
6	6	C	12	18	1E	24	2A	30	36	3C	42	48	4E	54	5A
7	7	E	15	1C	23	2A	31	38	3F	46	4D	54	5B	62	69
8	8	10	18	20	28	30	38	40	48	50	58	60	68	70	78
9	9	12	1B	24	2D	36	3F	48	51	5A	63	6C	75	7E	87
A	A	14	1E	28	32	3C	46	50	5A	64	6E	78	82	8C	96
B	B	16	21	2C	37	42	4D	58	63	6E	79	84	8F	9A	A5
C	C	18	24	30	3C	48	54	60	6C	78	84	90	9C	A8	B4
D	D	1A	27	34	41	4E	5B	68	75	82	8F	9C	A9	B6	C3
E	E	1C	2A	38	46	54	62	70	7E	8C	9A	A8	B6	C4	D2
F	F	1E	2D	3C	4B	5A	69	78	87	96	A5	B4	C3	D2	E1

For example, to find the product of 5 × 9, first find the row that begins with 5. Then move your finger to the right and stop at the column that has 9 at the top. Your finger should be on 2D (2 sixteens plus D ones).

Use the table to work the following problem in hexadecimal multiplication. Remember to regroup if the product in any place is greater than F.

Hexadecimal multiplication	**Meaning**	**Decimal multiplication**
$\overset{3}{5}6$	5 sixteens + 6 ones	86
×8	8 ones	×8
2B0	28 sixteens + 30 ones	688
	or, after regrouping,	
	2B sixteens + 0 ones	

In the ones place, use the fact 6 × 8 = 30. Regroup 30 ones as 3 sixteens and 0 ones. Write 0 in the ones place and a small 3 in the sixteens place above the 5. Then multiply 5 × 8 to get 28 and add the 3 to get 2B. Since 5 was in the sixteens place, the final result has B in the sixteens place and 2 in the sixteen times sixteen place.

When the multiplier has more than one digit, repeat the operation for each digit and add the products, as shown in the next example.

Hexadecimal product	**Decimal product**
$\overset{\overset{3}{1}}{2}B$	43
× 52	× 82
56	86
D7	344
DC6	3526

First, multiply 2B by 2. B × 2 = 16 ones. Write 6 in the ones place and regroup by adding a small 1 in the sixteens place. Next, multiply 2 sixteens by 2 to get 4 sixteens and add the 1 for the sixteen that was regrouped. Write 5 in the sixteens place. Next, multiply 2B by 5 (sixteens). B × 5 = 37 from the basic fact table. Write 7 in the sixteens column and regroup the 3 by writing a small 3 above the 1 that you got from regrouping the first step. Use the basic fact 2 × 5 = A. Then A + 3 = D and write D in the sixteen squared place. Adding ones, sixteens, and sixteens times sixteens, you get DC6.

Hexadecimal division. You can also use the hexadecimal multiplication table to find division facts. For example, to divide B into 58, first find the column that begins with B. Run your finger down this column until you come to 58. All the way to the left of this row, you will find the answer, 8.

Use the table to work the following problem.

Hexadecimal division	**Meaning**	**Decimal division**
1B	1 sixteen + B ones	27
$8\overline{)D8}$	$8 \text{ ones}\overline{)D \text{ sixteens} + 8 \text{ ones}}$	$8\overline{)216}$
8	8 sixteens	16
58	5 sixteens + 8 ones	56
58	5 sixteens + 8 ones	56

Think, "D sixteens divided by 8 is 1 sixteen." Write 1 above the D. Multiply 1 × 8 and write the product 8 below the D. Subtract 8 from D using the hexadecimal addition table. Complete the problem as you would in decimal division but use hexadecimal arithmetic facts.

History

How numeration systems began. Primitive people had several ways of recording the few numbers they needed. A shepherd could collect pebbles to represent the number of sheep in a flock. Each pebble meant one sheep. A bag of pebbles stood for the whole flock. By matching the pebbles against the flock, the shepherd could see if any sheep were missing. Mathematicians call this kind of matching *one-to-one correspondence.*

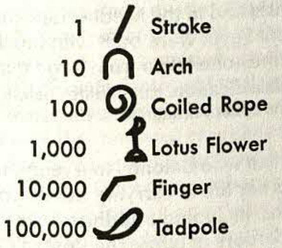
Later, people developed other ways to record the number of possessions they owned. They tied knots in a leather thong or scratched tally marks (𝍸) on the side of a rock. They then matched the knots or marks against each item.

Then people began to use words to represent numbers. These words described "how many" and helped people to match items mentally. For example, people used the word for "wings" to mean two objects. To refer to four things, they used the name of a fruit that grew in clusters of four. For five items, the word that meant "hand" was used. Such number-names appeared in various primitive languages. They showed that people had begun to form ideas of numbers. Whether they had three fish, three pebbles, or three tally marks, they recognized a "threeness" about each of these groups.

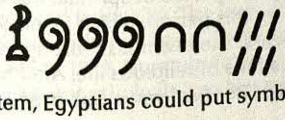
Finally, people began to *count* by arranging number-names in a certain order. To count, they spoke or wrote the word that meant "one," next the word for "two," then the word for "three," and so on. In time, people in many parts of the world developed various kinds of counting systems. Some were based on five, others on ten, and still others on twelve or sixty. We still use such measures as 12 inches in a foot and 60 minutes in an hour, taken from these ancient systems.

In most early numeration systems, people formed numerals simply by repeating basic symbols and adding their values to get the number they wanted. The Egyptians, Greeks, and Romans used numeral systems of this kind. The Hindus used a numeration system superior to all others. It followed the principle of place value and used a symbol that meant *not any.* This system became the decimal numeral system, now used in most parts of the world.

The Egyptian numeral system. About 3000 B.C., the ancient Egyptians used *hieroglyphics* (picture writing) to write numerals, as shown below.



This system was based on 10. But it did not include a zero symbol, nor did it use the principle of place value. The Egyptians formed numerals by putting basic symbols together. For example, they wrote the numeral 1,326 like this:



With this system, Egyptians could put symbols in any order, because the value of a symbol did not depend on its position.

The Greek numeral system. About 500 B.C., the Greeks developed a system based on ten. This system used a 27-letter Greek alphabet—the present-day 24-letter alphabet plus three letters no longer used. The first nine letters stood for numbers, from 1 through 9. The next nine letters stood for tens, from 10 through 90. The last nine letters were symbols for hundreds, from 100 through 900. The Greeks formed numerals by combining these symbols and adding their values.

The Roman numeral system uses letters as symbols for numbers. But the early Roman system of about 500 B.C. differed from the system we use today. For example, the ancient Romans wrote 4 as IIII and 9 as VIIII. They used the symbol ↆ for 50 and CIↃ for 1,000. Today, we use IV for 4, IX for 9, L for 50, and M for 1,000. The numerals VI, XV, and LX illustrate the *additive* principle. When the first of two symbols stands for a larger number than the second, you *add* the value of the first to the second to get the value of the combination. Thus, the Roman numeral VI represents 6, or 5 + 1; XV represents 15 as 10 + 5; and LX represents 50 + 10 = 60.

The numerals IV and IX illustrate the *subtractive* principle. When the first of two symbols stand for a smaller number than the second, you subtract the value of the first from that of the second to get the value of the combination. Thus, in the Roman numeral IV, you subtract 1 from 5 to get 4.

The Babylonian numeral system used *cuneiform* (wedge-shaped) symbols. An early system of about 2100 B.C. was based on 60. In this system, a numeral contained groups of symbols. One group stood for the number of ones, the next group stood for 60's, the next for (60 × 60)'s, and so on.

By 1500 B.C., the Babylonians had also developed a system based on 10. In this system, the numeral for "one thousand" was a combination of the symbols for "ten" and "one hundred."

The Hindu-Arabic numeral system. Hindu mathematicians of the 300's and 200's B.C. used a system based on 10. The Hindus had symbols for each number from one to nine. They had a name for each power of 10, and used these names when writing numerals. For example, Hindus wrote "1 sata, 3 dasan, 5" to represent the number we write as 135. They wrote "1 sata, 5" for the number we write as 105.

Probably about A.D. 600, the Hindus found a way of eliminating place names. They invented the symbol *sunya* (meaning *empty*), which we call *zero.* With this symbol, they could write "105" instead of "1 sata, 5."

During the 700's, the Arabs learned Hindu arithmetic from scientific writings of the Hindus and the Greeks. Then, in the 800's, a Persian mathematician wrote a book that was translated into Latin about 300 years later. This translation brought the Hindu-Arabic numerals into Europe.

Several hundred years passed before the Hindu-Arabic system became widely used. Many persons liked Hindu-Arabic numerals because they could easily use them to write out calculations. Others preferred Roman numerals because they were accustomed to solving problems on a device called an *abacus* without writing out the calculations. After the development of printing from movable type in the 1400's, many mathematics textbooks were published. Most of them showed calculations using the Hindu-Arabic system. These books brought the system into widespread use.

Mathematicians regard the Hindu-Arabic system as one of the world's greatest inventions. Its greatness lies in the principle of place value and in the use of zero. These two ideas make it easy to represent numbers and to perform mathematical operations that would be difficult with any other kind of system.

Rediscovering numeration systems. During the late 1600's, the German mathematician and philosopher Gottfried Wilhelm Leibniz (1646-1716) developed the binary numeration system. However, mathematicians found no practical use for the system until the 1940's, when computers were developed. Today, computers use the binary system.

During the 1950's and 1960's, many educators recognized the value of teaching numeration systems. Students began studying various systems as a part of what was called the "new mathematics." By doing arithmetic with unfamiliar systems, students gained a better understanding of the familiar decimal system and of arithmetic in general. However, in the 1970's, educators recognized that students also needed practice in solving everyday arithmetic problems and learning basic computational skills.

Related articles in ***World Book*** include:

Abacus
Algebra (Positive and negative numbers)
Arabic numerals
Arithmetic (Working with whole numbers)
Decimal system
Duodecimal numerals
Notation
Power
Roman numerals
Set theory
Zero

Outline

- **I. Kinds of numeration systems**
  - A. The decimal system
  - B. The binary system
  - C. The hexadecimal system
- **II. Working with numeration systems**
  - A. Decimal arithmetic
  - B. Binary arithmetic
  - C. Hexadecimal arithmetic
- **III. History**

Numerator. See **Arithmetic** (Common fractions); **Fraction.**

Numerology is the practice of using numbers to analyse character and foretell the future. It is based on the belief that the universe is governed by numerical laws and that each number has special powers and qualities. Most scientists believe that numerology has no scientific basis, but many people throughout the world practise it.

Numerologists believe that a person's name is an important clue to that person's character. Each letter in the name is changed to a number using a system based on ancient Greek and Hebrew alphabets. The numbers are added together and the separate figures in the total are combined to arrive at a number from one to nine. Suppose the numbers derived from a person's name total 75. The 75 is broken into a 7 and a 5, which add up to 12. The 12 is separated into a 1 and a 2, which total 3. This number supposedly reflects the person's character. For example, people with the number one are said to be ambitious and forceful. Those with the number two supposedly are quiet and shy.

Another number that numerologists believe reveals character is the *birth number,* which is determined by adding the figures in a person's birth date. Numerologists also combine the birth number with the figures in any year to find a *personal year number.* This number predicts what is going to happen to the person in that year.

See also **Fortunetelling.**

Numidia was an area in northern Africa during ancient times. It occupied part of what is now Algeria. Numidia was allied with nearby Carthage when the Second Punic War between Carthage and Rome began in 218 B.C. But Massinissa, a Numidian chieftain, sided with the Roman general Publius Cornelius Scipio. In return, as Scipio's ally, Massinissa was rewarded with territory and became king of all Numidia about 200 B.C. The next year, the Numidians helped Scipio defeat the Carthaginians, who were led by Hannibal, at Zama in northern Africa.

Several times after the war, Massinissa seized land from Carthage. Finally, Carthage fought back, helping bring about the Third Punic War (149-146 B.C.). Rome destroyed Carthage in the war, but also halted Numidian expansion. By 112 B.C., Jugurtha, adopted grandson of Massinissa, had seized all of Numidia in defiance of Rome. He was defeated by the Roman general Marius in 106 B.C. In 46 B.C., Numidian King Juba I fought Julius Caesar and was defeated. Caesar annexed Numidia and made most of it a Roman province. In 25 B.C., the Roman emperor Augustus placed the western part of Numidia under the rule of Juba II, king of Mauretania.

Numismatist. See **Coin collecting.**

Nummulite is the name for a large number of marine one-celled fossil animals. They can be recognized by their shells, which are shaped like flat discs. On the inside, each shell is coiled and divided into many little chambers. Most nummulites are a few centimetres across, but others are much larger. The large-shelled nummulites are really giants among single-celled animals.

During the Eocene and Oligocene periods of geologic time, nummulites lived in great numbers in the sea. Their shells made up thick layers of rock, especially in southern Asia and in the Mediterranean. The pyramids of ancient Egypt were built with blocks of such *nummulitic* limestone taken from large quarries.

Scientific classification. Nummulites belong to the phylum Protozoa and the order Foraminifera. They are in the family Nummulitidae.

Nun is a woman who belongs to a religious community and dedicates her life to carrying out its goals. Various major religions, including Buddhism, Christianity, and Taoism, have orders of nuns. The Roman Catholic Church has more of these orders than any other Christian denomination.

Most Roman Catholic orders of nuns have different requirements for permanent membership, but they all require years of preparation. When a woman enters an order, she begins a period of spiritual training called a *novitiate.* During this period, which in many orders lasts from 5 to 10 years, she becomes thoroughly acquainted with the obligations of religious life. After her novitiate, the woman takes her final vows. She promises to give up possession of worldly goods, obey her superiors in the order, and remain unmarried. These promises may be either *simple vows* or *solemn vows.* Solemn vows are more binding.

A woman who has taken simple vows is known as a *sister.* One who has taken solemn vows is properly called a nun. But the term *sister* is commonly used as a form of address for a nun.

The first convents for women were founded in the Egyptian desert during the early 300's by Saint Pachomius. During the Middle Ages, nuns led strictly *cloistered* (secluded) lives in such convents. In 1633, Saint Vincent de Paul founded the Sisters of Charity, an order devoted to charity work outside the convent. The members of this order cared for orphans and the sick and taught children and adults.

The nun's way of life was modernized by Vatican Council II, a worldwide council of the Roman Catholic Church held from 1962 to 1965. Many orders now permit their members to live in small informal groups rather than in a convent. Many nuns no longer must wear the traditional robe and veil. Nuns continue to work in charitable and educational fields.

Related articles in *World Book* include:

Carmelites
Convent
Dominicans
Franciscans
Little Sisters of the Poor
Sacred Heart of Jesus, Society of the
Sisters of Charity
Sisters of Mercy
Ursulines

Nuneaton and Bedworth (pop. 115,300) is a local government district in England that is an industrial area with traditional coal-mining and quarrying industries. The district is in Warwickshire, to the north of Coventry. Manufacturing is strong, making such products as engineering and metal goods, textiles, and vehicle components. The district lies just north of the M6 motorway, and employs many people in distributive trades.

The district's name comes from the two market towns it contains, Bedworth and Nuneaton. Nuneaton was the birthplace of novelist George Eliot (the pen name of Mary Ann Evans).

Nuremberg (pop. 465,255) is an industrial city in southern Germany. For the location of Nuremberg, see **Germany** (political map). The city's German name is Nürnberg. The Pegnitz River divides the central part of Nuremberg in half. A wall completed in the 1400's encircles the city's centre. Allied bombing attacks during World War II (1939-1945) destroyed or damaged many of Nuremberg's historic buildings. The city's remaining landmarks include the medieval churches of St. Lawrence and St. Sebaldus, and the restored house of the famous artist Albrecht Dürer. Nuremberg's many industries include the production of cars, beer, bicycles, electrical equipment, office machinery, and toys.

Nuremberg's founding date is unknown, but the city dates from at least the 1000's. During the late Middle Ages, Nuremberg became a prosperous trade and cultural city. Nuremberg was a centre of Nazi activities in the 1930's. In 1935, the Nazi-controlled German national assembly approved the anti-Jewish Nuremberg Laws, which were drafted in the city. The laws deprived Jews of citizenship and forbade "Aryan" Germans to marry Jews. From 1945 to 1949, Nuremberg was the site of Allied trials of Nazi war criminals (see **Nuremberg Trials**).

Nuremberg Trials were 13 trials held to judge leaders of Germany for their actions during World War II (1939-1945). The trials took place from 1945 to 1949 in Nuremberg, Germany, where the Nazi Party had staged huge rallies. This party, led by dictator Adolf Hitler, ruled Germany during World War II.

In the trials, Nazi leaders faced charges of committing aggressive acts and war crimes. These crimes included the murder of about 6 million Jews, known as the *Holocaust*, and 3 million to 5 million other Europeans.

The Nuremberg Trials were the first war crimes trials conducted by the victors of a war in modern times. They were organized by the United States, the Soviet Union, the United Kingdom (UK), and France.

The trials. The Nazi leaders were charged with crimes in three major areas—crimes against peace, war crimes, and crimes against humanity. The crimes against peace included carrying out wars of conquest. War crimes covered such acts as the murder of prisoners of war and of civilians, and the excessive destruction of land and cities. Crimes against humanity referred to three main offences: (1) deporting civilians and using them for slave labour, (2) conducting inhumane medical experiments, and (3) persecuting and murdering people because of political beliefs, race, or religion.

A group called the International Military Tribunal conducted the first trial. This trial ran from November 1945 to October 1946. It had eight judges, two each from the United States, the UK, France, and the Soviet Union. Twenty-two people were tried. They included such chief Nazi Party advisers and diplomats as Hermann Goering, Albert Speer, Rudolf Hess, Joachim von Ribbentrop, and Martin Bormann. Military leaders who were charged included Grand Admiral Karl Doenitz and Colonel General Alfred Jodl. Hitler and two of his chief aides, Joseph Goebbels and Heinrich Himmler, committed suicide or had themselves killed before the trials.

The judges convicted 19 of the defendants. Twelve of them including Bormann, Goering, von Ribbentrop, and Jodl, received death sentences. Ten of these people were hanged on Oct. 16, 1946. Goering committed suicide a few hours before. Bormann's whereabouts were unknown at the time, and he was tried *in absentia* (while absent). Hess, Doenitz, and five others received prison sentences ranging from 10 years to life.

Twelve more trials took place at Nuremberg from 1946 to 1949. These trials were conducted by U.S. judges. They involved 185 defendants, including Nazi Party officials, judges, business executives, and doctors. More than half of those tried were sent to prison, some received death sentences, and others were found not guilty.

The Nuremberg Trials emphasized the idea that soldiers and citizens have a moral duty to disobey inhumane orders or laws.

See also **International law; War crime.**

Nureyev, Rudolf (1938-1993), was one of the greatest ballet dancers of the 1900's. He became known for his exciting stage personality and his strong, expressive dance technique. Nureyev danced more than 100 roles. In 1962, he began a partnership with the famous English ballerina Dame Margot Fonteyn. They performed together in such ballets as *Giselle, Swan Lake,* and *Les Sylphides.* As a *choreographer* (dance composer), Nure-

Rudolf Nureyev became one of the most famous ballet dancers of the 1900's. He won praise for his exciting stage personality and powerful leaps in such ballets as *Swan Lake, above.*

yev created new versions of several ballets, including *Don Quixote, The Nutcracker,* and *Raymonda.*

Nureyev was born near Irkutsk, in Russia. He joined the Kirov Ballet in 1958, and soon became its principal dancer. In 1961, Nureyev defected to the West while the Kirov Ballet was performing in Paris. He then danced with ballet and modern dance companies throughout the Western world and appeared in several dance films. Nureyev served as director of the Paris Opera Ballet from 1983 to 1989.

See also **Ballet** (picture: *Swan Lake*); **Fonteyn, Dame Margot** (picture).

Nuri as-Said. See **Said, Nuri as-.**

Nurmi, Paavi Johannes (1897-1973), was a Finnish runner who won nine Olympic gold medals and set 29 world records over 16 separate distances.

Born in Turku, the son of a carpenter, Nurmi adopted a methodical, scientific approach to running while still a boy. At the age of ten, he ran 1500 metres in 5 mins, 03.0 secs. In 1920 at Antwerp, Nurmi became Olympic 10,000m champion, a title he regained in 1928 in Amsterdam. At the 1924 Olympics in Paris, Nurmi won the 1500m and 5000m within 90 minutes. His world records were set between 1921 and 1931 at distances from 1500 to 20,000 metres.

Nurmi was renowned for his long, even strides and impassive manner. He was torch bearer at the 1952 Olympics in Helsinki. A national hero until his death, Nurmi received a state funeral.

Nurse. See **Nursing; Hospital.**

Nursery produces young plants for transplanting in fields, gardens, orchards, and landscaped areas. Nurseries grow fruit and forest trees. They also grow ornamental shrubs, flowers, foliage plants, and vegetables.

Most nurseries are commercial operations, and are sited near centres of population. Many nurseries sell soils, potting compost, and pots and containers, as well as the plants themselves. Some also provide a whole range of gardening materials, including tools, fertilisers, garden furniture and pools. Such nurseries are often referred to as garden centres.

Nurseries produce plants from seeds or cuttings. They also produce plants by grafting buds or stems from mature plants onto roots grown from seeds or cuttings. In addition, certain plants are grown from bulbs or other plant structures. Nursery workers care for the plants by fertilizing and irrigating the soil, and by protecting them from disease, insects, and weeds.

Many nursery plants are sold in the containers in which they grew. Some field-grown plants are sold with their roots and soil wrapped in sacking. Others are sold with the soil removed.

There are three kinds of commercial nurseries. *Wholesale nurseries,* which sell to other nurseries, handle large quantities of relatively few kinds of plants. *Retail nurseries* sell directly to the public. They handle relatively small quantities of many kinds of plants. Most of these nurseries operate along busy roads, where they can be reached easily. Some provide planting and maintenance service and also offer planting designs for gardens. *Mail order nurseries* distribute catalogues that describe the plants they sell. Many of these nurseries grow only a small portion of their plants. They buy the rest from wholesale nurseries.

Nursery rhyme is a rhythmical poem intended to amuse young children. These verses, which are a form of folk literature, appeal to children because of their pleasing rhymes and sounds and their strong rhythms. Youngsters often keep time with the rhythm of the words by clapping their hands or rocking back and forth.

The great variety of stories and characters in the verses stimulates the imagination. Children delight in the humour and surprises in such rhymes as "Mary Had a Little Lamb" and "Hey Diddle Diddle." Other rhymes, including "Three Little Kittens" and "Old Mother Hubbard," introduce children to their first stories. A child's familiarity with nursery rhymes can lead to a lasting appreciation of poetry and prose.

Types

The most popular types of nursery rhymes include (1) lullabies, (2) singing game rhymes, (3) nonsense rhymes, (4) rhyming riddles, (5) counting-out rhymes, (6) tongue twisters, (7) verse stories, and (8) cumulative rhymes.

Lullabies are simple, soothing melodies sung to children to help them fall asleep. "Rock-a-bye Baby" is the best-known lullaby in the English language.

> Rock-a-bye, baby, on the tree top,
> When the wind blows the cradle will rock;
> When the bough breaks the cradle will fall,
> Down will come baby, cradle, and all.

Singing game rhymes accompany dances or certain games. For example, "Ring-a-Ring O'Roses" is sung by a group of children who join hands and dance in a circle.

> Ring-a-ring o'roses,
> A pocket full of posies,
> A-tishoo! A-tishoo!
> We all fall down.

Nonsense rhymes are created just for fun. This one has the humour and wit typical of such verses.

If all the world were paper,
And all the sea were ink,
If all the trees were bread and cheese,
What should we have to drink?

Rhyming riddles ask children to identify a certain object from clues in the verse.

Runs all day and never walks,
Often murmurs, never talks;
It has a bed and never sleeps;
It has a mouth and never eats.

The answer is a *river.*

Counting-out rhymes are formulas that help children choose sides for a game. The verse "One, Two, Three, Four, Five" is an example.

One, two, three, four, five!
Once I caught a fish alive;
Six, seven, eight, nine, ten!
Then I let it go again.

Such rhymes may also help children learn the days of the week, the months of the year, and how to count.

Tongue twisters are difficult to say without making a mistake. The fun of these rhymes comes from reciting them accurately as fast as possible. "Peter Piper" is a famous tongue twister.

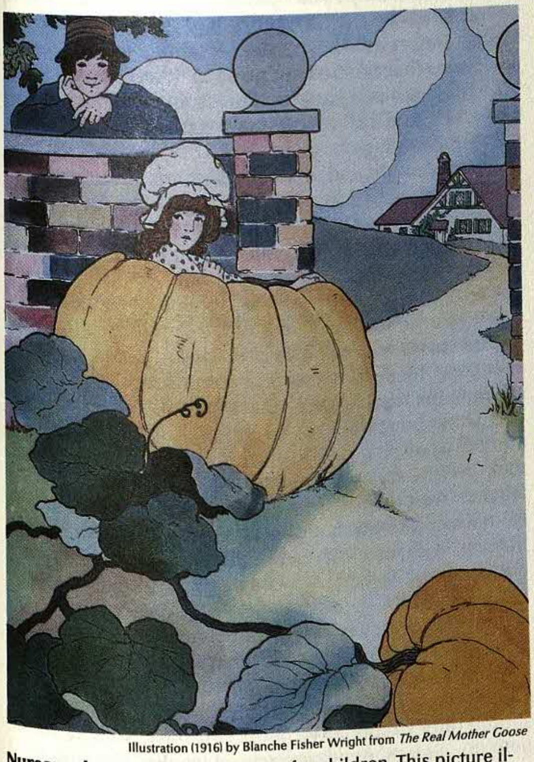


Illustration (1916) by Blanche Fisher Wright from *The Real Mother Goose*

Nursery rhymes are short poems for children. This picture illustrates the nursery rhyme "Peter, Peter, Pumpkin-Eater," which tells about a man who keeps his wife in a pumpkin shell.

Peter Piper picked a peck of pickled peppers;
A peck of pickled peppers Peter Piper picked;
If Peter Piper picked a peck of pickled peppers,
Where's the peck of pickled peppers Peter Piper picked?

Verse stories are short dramatic tales that have many interesting characters. Most of these rhymes are longer than other types of nursery rhymes. "The Queen of Hearts" is a popular verse story.

The Queen of Hearts,
She made some tarts,
All on a summer's day;
The Knave of Hearts,
He stole those tarts,
And took them clean away.
The King of Hearts
Called for the tarts,
And beat the knave full sore;
The Knave of Hearts
Brought back the tarts,
And vowed he'd steal no more.

Cumulative rhymes, in each successive verse, repeat the information presented in the earlier verses. Thus, each verse is longer than the previous one. Here is the first verse of "The House That Jack Built."

This is the house that Jack built.

The second verse has two lines.

This is the malt
That lay in the house that Jack built.

The third verse adds another line to the story.

This is the rat
That ate the malt
That lay in the house that Jack built.

This cumulative rhyme then continues for many more verses.

History

For centuries, nursery rhymes have been passed orally from generation to generation. Every culture has its own nursery rhymes, plus additional ones that belong to other societies as well. The verses have a wide variety of origins. Some nursery rhymes are fragments of ballads, prayers, proverbs, or tavern songs. Others came from ancient customs or rituals. Still others, including "Old King Cole" and "Hey Diddle Diddle," may have been based on real people and events. Many nursery rhymes have a number of versions.

No one knows for certain how old nursery rhymes are. Most nursery rhymes probably originated after 1600, but some rhymes were created earlier. One of the earliest known collections of nursery rhymes is *Tommy Thumb's (Pretty) Song Book.* It was published in London in 1744 in two volumes. Only one copy of the second volume has survived. Another early English collection is *Mother Goose's Melody,* which was brought out in 1781 by an English publisher.

Many nursery rhymes that date from before 1800 were intended to entertain adults, not children. The only rhymes written especially for youngsters were alphabet rhymes, lullabies, and verses that accompanied games.

The term *nursery rhyme* first appeared in print in 1824 in *Blackwoods's Edinburgh Magazine,* a Scottish periodical. Before then, the rhymes were called songs

Children in nursery schools participate in many activities. These children are listening as their teacher reads a story.

or ditties. James Halliwell, a British author, compiled the first large-scale collections of nursery rhymes, called *The Nursery Rhymes of England* (1842) and *Popular Rhymes and Nursery Tales* (1849). They served as the basis of nursery rhyme collections in English until the publication in 1951 of *The Oxford Dictionary of Nursery Rhymes.* This work was edited by Iona and Peter Opie, a husband-and-wife team of British scholars.

See also **Folklore; Literature for children** (Poetry; Books to read [Beginning books]); **Mother Goose; Newbery, John.**

Nursery school is a school chiefly for children who are 3 or 4 years old. The youngsters learn through a variety of play and creative activities supervised by specially trained teachers. Nursery school, also called *preschool* or *playschool,* helps children develop their intellectual and physical skills and learn to get along as members of a group. The school also teaches them good health and safety habits and encourages independence.

Nursery schools differ from *day nurseries* or *day-care centres,* which chiefly care for preschool children while their parents are at work. Usually, these centres provide educational programmes similar to those of nursery schools.

Nursery school methods

The children in nursery schools spend most of their time playing or in activities they have chosen instead of doing work assigned by the teacher.

The nursery school has areas called *activity centres.* Each centre has different equipment and materials for the children to use.

Learning through play. A nursery school features long periods of play because young children learn best by playing. Preschool youngsters cannot grasp the meaning of words that represent unfamiliar objects or situations. As a result, these children learn better by direct contact with things than by using words alone. Nursery school children learn the names, characteristics, and uses of objects with which they play. The youngsters handle things, compare them, count them, and move them around. These activities help children understand directions, distances, numbers, shapes, and sizes.

Nursery school children also develop social skills through play. They learn to get along in a group, to share, and to resolve difficulties in a friendly way. The children also learn to express ideas and to listen to the ideas of others.

A number of nursery schools use a teaching technique developed by the Italian educator Maria Montessori. The Montessori method involves special learning activities that children choose for themselves and work with individually. For more information, see **Montessori method.**

A nursery school day lasts two or three hours and provides a balance of active and restful experiences. The children begin a typical day by sitting on the floor or on low chairs talking with the teacher. They might chat about recent experiences or about an object that the teacher or a child has brought to school. The class might also discuss plans for the day.

The children work alone or in groups at activity centers, and the teacher gives individual help. Some children build with blocks. Others dress up and pretend to be parents, policemen, or other adults. Other children draw, paint, or work with clay. Some youngsters use puzzles, peg sets, or educational games. Still others look at picture books or listen to records. Each of these activities helps children learn in different ways.

After an indoor activity period, the teacher and helpers assist the children in cleaning up the classroom and putting away their materials. The class then might take a rest, have a snack, or listen to a story.

Many nursery schools also have an outdoor activity period, which helps youngsters develop strength and coordination by climbing, jumping, running, and other forms of exercise. The outdoor area might have boards and boxes that can be combined in different ways for play. Most schools have sandboxes or sand pits, tricycles, carts, and a climbing frame or some other structure for climbing.

The day might end with a music and movement period, during which the children sing, dance, or move to rhythm. When they are ready to go home, the youngsters may get experience putting on their coats and shoes or boots by themselves.

The nursery school teacher

The teacher's role is to provide education, care, and affection. The children receive some education directly, as when the teacher gives them information or tells stories. Other education comes indirectly, such as the creation of a learning opportunity that children can use on their own. Nursery school children are so young that the teacher must provide physical care and protect them from harm. The teacher must also establish a warm relationship with the children and help them to feel good about themselves. Youngsters need much individual attention as well.

A person who wants to be a nursery school teacher should like and respect children from all backgrounds. A teacher needs to be intelligent, well educated, and able to relate warmly to young children. The teacher should understand how children develop and how to help them learn. A nursery school teacher also must know how to work with parents and other adults for the welfare of children.

A nursery school provides young children with the opportunity to begin learning through play. Properly organized schools have well-planned play areas and equipment. A lawn helps to limit injuries.

Institutions similar to nursery schools were established during the 1800's under such names as *crèches, infant schools,* and *maternal schools.* In the early 1900's, two British sisters named Margaret and Rachel McMillan set up one of the first institutions in England called a nursery school. Their school, located in a slum area of London, was designed to give poor children the benefits that wealthy children received in home nurseries.

Nursing is a profession devoted to the care of sick people and also to the prevention of illness. Most nurses work in hospitals. Other nurses attend sick patients in their own homes. Many other nurses assist doctors at dental and medical clinics, in schools, in nurseries, in shops and factories, in the armed forces, and on ships, trains, and aeroplanes. Nurses with special training may also teach in schools of nursing, training men and women to become nurses.

Nursing is now a registered profession in most countries. Nurses have to pass examinations and be registered before they can practise as qualified nurses. As a rule, their training takes three years. They may have a preliminary course before taking a general course in a wide range of subjects. Some of them later take an advanced course in special subjects. Most nurses are women, but there are increasing numbers of male nurses in many different fields of nursing.

Kinds of nursing

Hospital nursing. Many nurses serve as general-duty or staff nurses in hospitals. They work with doctors and other members of the health and healing team in helping a patient to recover. They may also work in the operating theatre as important members of the surgical team. The nurses may care for newborn babies in maternity wards. They may administer injections or medicine to a patient, or assist the doctors in giving blood transfusions and in many other skilled procedures.

The well-being of a patient is of first importance to the hospital nurse. Nurses take charge of the patient's routine care. They make sure that the patient receives the treatment the doctor has ordered. They keep the patient continuously under observation, and report to the doctors any change in the patient's physical condition, mental attitude, or reaction to the prescribed drugs and treatment. Nurses are trained to recognize and understand the needs of patients and to give emotional support as well as physical care. They find time to boost the morale of patients and calm their fears.

An experienced nurse may be appointed to supervise a group of nurses and patients in a ward or some other unit in the hospital. After additional education they may be given charge of several wards. Or they may specialize in one kind of nursing and become head nurse of a unit, such as the operating theatre or out-patients' department. Nurses may work in a mental hospital. They do the same work as a general-hospital nurse, but need special training because of the special needs of patients.

Dental nurses care for the teeth of children in some countries, usually as part of a school dental service.

Most nurses work in hospitals, where they help comfort and care for people who are sick, injured, or recovering from surgery. This nurse is taking a patient's blood pressure.

A nurse with post-registration education and experience has opportunities to teach, or do administrative work.

Nurses may take specialist courses after they complete their basic education. They will then concentrate on specific areas and therapies and the ways diseases affect the individual. They may specialize, for example, in accident and emergency; orthopaedic or paediatric nursing. Or they may go into intensive-care nursing, or spend some time as an operating theatre nurse.

Accident and emergency nursing deals with people who have suddenly become ill or have had an accident. Patients may have a wound that needs stitches. They may have had a heart attack, or been in a road traffic accident, and require further treatment in hospital.

Orthopaedic nursing is concerned with the care of people with bone or joint disorders. The commonest conditions are broken bones—especially among children and the elderly—and arthritis. Patients may need to stay a long time in an orthopaedic ward, so the nurses have a chance to develop a good relationship. Much of the work involves *rehabilitation* (preparing to return to normal life).

Paediatric nursing deals with patients that are children. It is a highly specialized field, because children suffer from different conditions from adults and have different physical and emotional needs. Their responses to infection, injury and treatment also differ from that of adults. Paediatric nurses understand the effects of hospitalization on a child's development and offer emotional support to the families of sick children.

Intensive care nursing concentrates on the care of critically ill, highly dependent patients. It may involve caring for a person who is unconscious and dependent on machines to breathe and receive nutrition. Intensive care nurses use a wide range of high-technology equipment and, at the same time, develop an awareness of the individuals in their care.

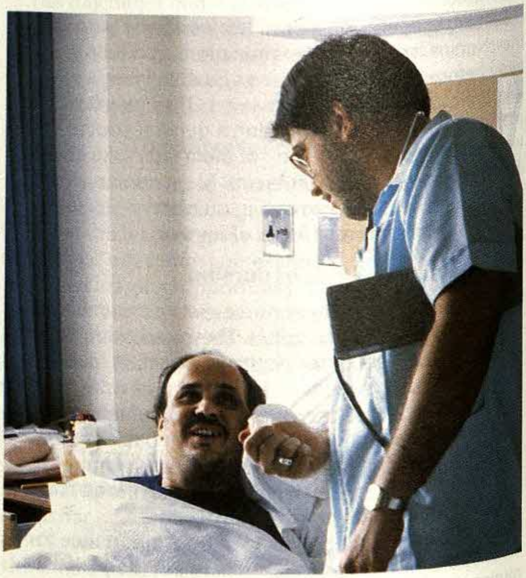
Operating theatre nursing requires great skill and efficiency. The theatre nurse assists surgeons in all types of procedures. They may also visit patients before surgery, to help them understand their operation and to answer any questions.

Nursing in the community

Many nurses provide care in the community. Nurses in the community have many responsibilities. They promote good health and independence, helping to prevent illnesses as well as treating them. Many sick people now receive medical treatment at home, or leave a hospital ward after only a brief stay. In addition, many governments are adopting the community-based *Health for All* strategy of the World Health Organization (WHO). This strategy recognizes that health depends on many factors, including a safe environment, adequate diet and housing, and good health education.

Health visitors are registered nurses who also have qualifications in community nursing and obstetrics or midwifery. The health visitor aims to promote health and prevent illness. For example, in some countries the health visitor sees babies and mothers at regular intervals and monitors each baby's growth and development. The health visitor also advises the parent on all aspects of childcare, including immunization.

Experience with families allows the health visitor to



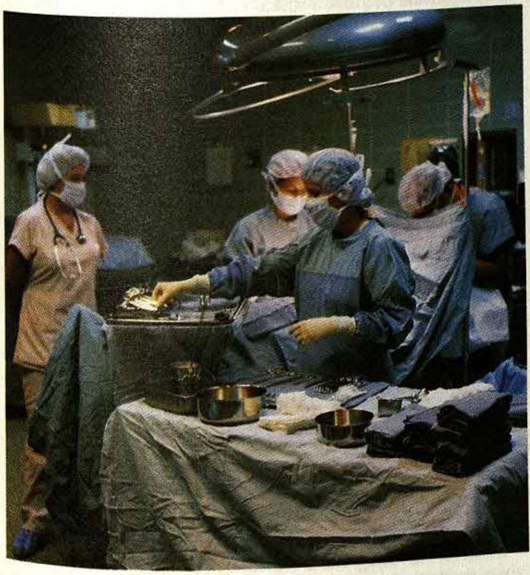
A male nurse gives medication to a patient. Although most nurses are women, more and more men are enrolling in nursing education programmes or pursuing careers in practical nursing.

identify families and children who need extra help or are "at risk". The nurse watches for signs that a child is unhappy or being treated badly, and may recommend professional counselling. Some health visitors specialize, for example, in counselling young people, or advising families that have problems with drinking or drugs. With the support and care of health visitors, elderly and infirm people can remain in their own homes, instead of going into a nursing home. Elderly people are vulnerable to cold and infection; they have accidents more frequently and may become forgetful. Health visitors work with many caring agencies, including social services, "meals on wheels" and district nurses to ensure the well-being of the people in their care.

District nurses provide nursing care for sick and disabled people in their own homes. Some of their patients may have chronic conditions—for example, diabetes, or paralysis caused by a stroke. Other patients need short-term nursing after discharge from hospital. The district nurse has to take into account the patient's living conditions and surroundings when planning the care the person needs. The nurse also looks after other family members, teaching them to care for their relative and supporting them at a time of emotional stress.

The care of sick people at home requires a great deal of support from other community agencies. These agencies usually include the general practitioner, social workers, occupational therapist and physiotherapist, and day centre and voluntary organizations. The district nurse is in a good position to evaluate the benefits of a multi-disciplinary team and make suitable recommendations for care and assistance.

Practice nurses are based in a health centre which patients visit for treatment or consultation with their own *general practitioner* (doctor). Practice nurses care for people who attend that health centre, and are involved in all aspects of nursing care, including immunization, and health education and promotion. Practice nurses may offer counselling services, or advise on health issues such as stress and smoking.



Theatre nurses assist surgeons during operations. These nurses must react instantly and accurately to the surgeons' requests for operating instruments.

Community psychiatric nurses (CPN's) are becoming increasingly important as fewer people stay in hospital for treatment. Psychiatric patients in the community often require long-term care from a CPN, who administers and monitors drug treatment, liaises with the psychiatrist, or advises other health care professionals. The CPN may support the patient and his or her family over many years.

Many CPN's are now part of teams belonging to local health centres. They may specialize in one area of care, such as family therapy or work with the elderly. Preventive psychiatric nursing aims to identify and treat illness at an early stage, when therapy can be more successful. It also helps people overcome problems such as prejudice and unemployment.

Teaching is central to nursing. Nurses teach on many levels. They may take part in a public health campaign, informing people how to maintain their health and avoid disease. Or, they may be involved in clinics for groups such as diabetics or expectant mothers. Other nurses teach within their own profession, to students or less experienced nurses. Specialized nurses may offer continuing education in specialist fields. In hospital, nurses help patients learn to deal with their illness and overcome disability.

Occupational health nurses often work for private industry instead of for government-financed health services. They look after the well-being of employees, take care of accidents and emergencies, and offer counselling services. Occupational health nurses are also responsible for monitoring the workplace and maintaining a healthy and safe environment for all employees.

Nursing as a career

Nursing is a satisfying career for those who have a genuine desire to help other people. The profession has such a wide range of jobs that a capable nurse can always be sure of obtaining work.

Nursing is a challenging and at the same time a rewarding vocation. A badly injured person may need immediate and expert care. Medicines and equipment must be taken quickly by the nurse to the patient. The nurse must give the doctor a detailed report on the patient's condition, and also comfort the patient's relatives. A nurse's greatest reward is the knowledge that her skill has helped to relieve suffering or even saved a life.

Training a nurse

A prospective nurse must be a person who likes people and wants to help them. Self-reliance and good judgment is also important. Patience, tact, honesty, responsibility, and ability to work easily with other people are valuable traits to possess, as well as good health.

Nursing schools accept candidates with a good educational background from college or secondary school. Entrance requirements for assistant-nursing courses are less exacting, although candidates with a good all round education are preferred. Traditionally, the training of nurses has been almost entirely based in hospital. During their training, student nurses would have spent most of their time on the wards where they learned nursing procedures under the supervision of more senior nurses. Today, some countries maintain this system while others, such as the United Kingdom (UK), Australia, and the U.S.A., are moving toward full-time nursing studies at university or a college of higher education.

The training course for a nurse in most hospital training schools generally lasts three years. A student nurse goes through a preliminary training period before undertaking a general course of lectures and practical training. The student studies in classrooms and laboratories, and works with patients in hospitals. Many hospitals provide board, lodging, and uniform for the student nurse. The successful student becomes a *registered* nurse after graduating from the course.

Classroom work. Student nurses study such subjects as anatomy, nutrition, pharmacology, physiology, and the fundamentals of nursing care. They often learn to care for the sick by practising nursing on each other. For example, one student may take another's temperature, blood pressure, and pulse rate. The students may first learn how to use a hypodermic needle by injecting a specially designed model.

Clinical experience. In every course of nursing, classroom study is balanced with practice. Many hospital training plans now use a "study day" each week or "block" period of study for a number of weeks each year. Clinical experience, or practice, is the knowledge gained by a student in caring for different patients. As part of clinical experience, the nurse learns about hospital routine and the functions of various units in the hospital, and obtains the "feel" of hospital life.

Licensing or state registration. In most countries, the student nurse completes a course of training by taking examinations set by the state nursing authorities. In some countries this authority is the state board of health, and in other countries it is a general nursing council. When student nurses pass the examinations they receive a licence or are registered to practise their profession. Registered nurses may advance their career by additional study and experience. They can qualify for specialized jobs, teaching, or administration, by taking a post-graduate diploma or degree.

The history of nursing

People have been practising some form of nursing care for thousands of years. For example, the ancient Hebrews and Egyptians hired women, later called *midwives,* to assist at births.

Nurses first organized themselves into groups during early Christian times. Noblewomen, including the wives of emperors, helped to care for sick people in ancient Rome. During the crusades, military nursing orders of monks and knights tended the sick and wounded (see **Crusades**).

Many monasteries in Europe closed during the Reformation in the 1500's, and there were fewer places where religious orders could nurse the sick. The years from 1600 to 1850 were the darkest period in the history of nursing. Hospitals were often built as charity hospitals, and were usually staffed by untrained, sometimes disreputable women. Wealthy people never went to hospitals for treatment, but engaged their own doctors. The hospital staffs did not then understand the importance of sanitation and hygiene. Doctors did not know how diseases caused epidemics. Often nurses who took care of patients with contagious diseases contracted the same disease themselves.

Modern nursing began in the 1850's with the work of the English nurse Florence Nightingale, the founder of professional nursing. Nightingale established the first school of nursing, the Nightingale School for Nurses at St. Thomas' Hospital in London in 1860. Nightingale entered the nursing profession at a time when many people felt that nursing was unsuitable work for the daughter of wealthy parents. But her work at Scutari during the Crimean War (1853-1856) brought her international recognition, and enabled her to bring about major reforms in nursing throughout the world. She established nursing as a noble profession.

There were few examples of nursing at this time. In Germany, religious women called *deaconesses* had founded a nursing institution, and the British prison-reformer Elizabeth Fry had opened the Institute of Nursing in Bishopsgate, London. Catherine McCauley founded the Roman Catholic Sisters of Charity in Ireland, and some Church of England sisterhoods devoted themselves to nursing the poor.

Since then many countries have created national nursing organizations, and made nursing into a highly respected vocation with legal status. An International Council of Nurses was formed in 1901 to raise the standard of the profession all over the world. In 1949, the council became officially associated with the World Health Organization.

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Nursing home is a residential institution that provides medical or nonmedical care, chiefly for people who are 65 years old or older. Nearly all homes also accept younger patients. The best ones strive to provide a comfortable, homelike environment for their residents.

Most nursing homes are privately owned. Some private nursing homes are run by companies, which try to make a profit for the owners. Others are sponsored by religious or civic groups, which do not try to make money. Laws normally govern the operation of nursing homes and the institutions are required to have a licence. The homes are inspected periodically to make sure they follow these laws. Other small specialist private hospitals may also be nursing homes. For example, in the United Kingdom, some private maternity hospitals are called nursing homes.

Types of nursing homes

There are three types of nursing homes: (1) skilled nursing care homes, (2) intermediate care facilities, and (3) supervised personal care homes. They differ according to the types of patients they care for and the kinds of services they offer.

Skilled nursing care homes provide more extensive services than the other types of nursing homes. For example, they offer diagnostic, laboratory, and medication services; therapy programmes; and dental care. Registered nurses supervise the care of patients according to the instructions of the institution's medical director. Doctors visit these homes frequently.

Most of the patients in skilled nursing care homes require medical attention around the clock. Some have serious illnesses or disabilities. Others stay in these institutions after being hospitalized. They receive additional treatment before returning home.

Most skilled nursing care homes have transfer agreements with hospitals, intermediate care facilities, and other health-care institutions. Patients who become so ill that they need more medical care than a nursing home can provide are taken to a hospital. Those whose health improves, but who still require some nursing care, are transferred to an intermediate care facility or other health-care institution.

Intermediate care facilities, also called *basic nursing care homes,* provide basic nursing services. Registered nurses examine the residents periodically to determine what treatment is needed. Most patients in intermediate care facilities suffer from a long-term illness. However, they require only minor medical care. Doctors visit these nursing homes regularly. Registered nurses direct the nursing in intermediate care facilities, but an administrator runs these institutions.

Supervised personal care homes provide nonmedical services. These services include preparing and serving the residents' meals and helping the men and women care for themselves. For example, members of the staff assist residents who have difficulty dressing themselves. The institutions also plan social activities. Most residents of supervised personal care homes need only routine medical examinations, and doctors visit these homes only when necessary. A supervisor of residential care directs the services provided.

Selecting a nursing home

Quality of care. In selecting a nursing home, it is important to match both the medical and psychological needs of a person with the resources of the institution.

For example, not all elderly people require the same amount of medical care. A study of nursing homes revealed that a number of relatively healthy people lived in institutions that had extensive medical facilities. The study also found that many people who needed medical treatment lived in nursing homes that did not have adequate medical services.

Nursing homes also should provide for the psychological needs of their residents. Most people in nursing homes can still lead fairly productive lives. However, some low-quality institutions have few or no activities for residents. The best nursing homes encourage residents to have hobbies and to participate in a variety of community service and social activities.

Emotional effects. Many families feel guilty about placing an elderly relative in a nursing home. In most cases, they agree to this action only as a last resort. They do so when the person's health problems grow too severe and the family's social and financial resources become too strained to keep the relative at home.

Many elderly people suffer stress when they must adjust to the unfamiliar environment of a nursing home. Some old people regard it as the final step before death. The strain of the move can result in depression, increased health problems, and, in certain cases, even death. There are several ways to lessen the strain on elderly people, including involving them in the decision to move to a nursing home and in the choice of a facility. The institution should allow patients to keep personal belongings in their new room. It also helps to choose a home where the staff is well trained and concerned about the patients.

Nusantara is a name for the islands that make up Indonesia. *Nusa* is the Javanese word for "island." *Antara* means "between" in the ancient Indian language of Sanskrit, as well as in Javanese and Indonesian.

Nusantara was an old Javanese word used as early as the A.D. 1300's. It meant "the other islands" apart from Java. Nusantara has now come to mean *archipelago,* a cluster of islands.

In the 1920's, Suardi Suryaningrat, an Indonesian nationalist, found the word in old Javanese sources. He brought it into use again as a name for the Indonesian region. President Sukarno used it in some of his speeches. But Indonesians as a whole preferred the word "Indonesia." Indonesia became the official name when the republic was proclaimed in 1945. Nusantara is still used in Indonesian and Malay. But it refers to the whole Indonesian archipelago, not just the Republic of Indonesia.

Nut, Egyptian goddess. See **Mythology** (Egyptian mythology).

Nut is the popular name for many kinds of dry, edible seeds or fruits that grow in a woody shell. The word *nut* can refer to both the shell and the nutmeat, or kernel, inside or to the kernel alone. Nut-bearing plants grow in almost every part of the world.

Botanists define a nut as a dry, one-seed fruit surrounded by a hard shell that does not open on its own. In fact, only a few common nuts fit this narrow definition. Hazelnuts (filberts) and sweet chestnuts are true nuts, but most other types, such as almonds, walnuts, Brazil nuts, and peanuts, are not. In fact, peanuts are a type of pea (see **Peanut**).

Uses of nuts. Most people eat nuts as snacks or use them as flavouring in cooking certain dishes. They are also used in vegetarian dishes as a replacement for meat. Most nuts are rich in protein and fat, though sweet chestnuts and a few others contain more starch than protein. In Italy, bread is sometimes baked with a flour made from sweet chestnuts.

People in prehistory probably ate nuts as a regular part of their diet. Some nutritionists believe that, because of food shortages, nuts will again become a widely used source of protein.

In addition to their value as food, some nuts provide useful oil. For example, peanut oil and walnut oil are used in cooking. Walnut oil is also used to clean and polish wooden furniture. Jojoba nuts furnish a valuable lubricant for precision instruments. Tung oil is used in paints and varnishes.

Kinds of nuts. Hundreds of species of trees and shrubs produce nuts, but only about 25 kinds of nuts are grown as crops.

Sweet chestnuts are gathered from planted trees or from woodland in many countries, particularly in southern Europe. The nuts are roasted and eaten whole, or turned into a purée sauce. In earlier times they were ground up to make a sort of flour for bread-making. Beech nuts are sometimes gathered as food for pigs and poultry.

Pecans are grown in Australia, Mexico, South Africa, the Middle East, and the United States.

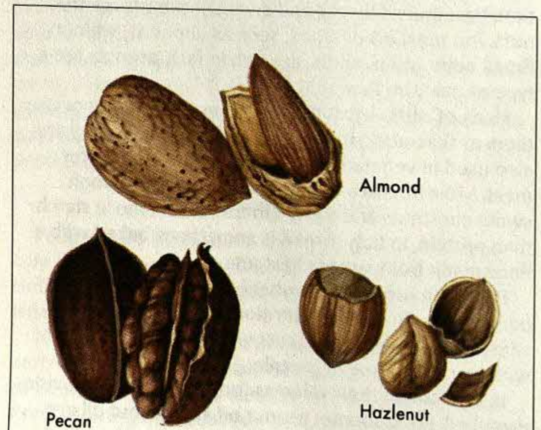
Pistachio nuts are grown in western Asia, the Mediterranean region and in North America. They have a delicate flavour and a striking green colour, and are often used in ice-cream. Cashew nuts grow naturally in Brazil and are cultivated throughout South America, India, and East Africa. Cashews have a sweet flavour and are rich in fat and protein.

Peanuts are seeds from the underground pods of a tropical relative of the pea. Peanuts are mainly grown as a source of oil, but some are harvested as nuts.

Macadamia trees were first taken to Hawaii from Australia in the late 1800's. Today, Hawaii ranks as the world's chief producer of macadamia nuts. Brazil nuts grow on wild, uncultivated trees in the Amazon River region of South America.

Nut growing. Most kinds of nut trees produce nuts only if they have been *cross-pollinated*—that is, pollinated by flowers from another tree of the same species. Nut growers raise new trees by grafting certain parts of one tree to the roots of another (see **Grafting**).

Nut trees—and nuts themselves—may be damaged by a number of pests and diseases. For example, mice, squirrels, weevils, and some species of birds eat nuts and feed on nut crops. Nut trees can be harmed by certain insects and diseases that attack the leaves, stems, or nuts. Nut growers commonly protect their crops from insects and diseases by spraying the trees with pesticides. They use firearms, mechanical barriers, poisons, repellents, traps, and various other means to control birds and rodents.



Nuts grow nearly everywhere in the world. The most popular nuts include peanuts, almonds, pecans, hazelnuts, and walnuts.

Scientific classification. Hazelnut is *Corylus avellana;* sweet chestnut, *Castanea sativa;* almond, *Prunus amygdalus;* walnut, *Juglans regia;* pecan, *Carya illinoinensis;* Brazil nut, *Bertholletia excelsa;* peanut, *Arachis hypogaea;* pistachio, *Pistacia vera;* jojoba nut, *Simmondsia chinensis;* tung nut, *Aleurites fordic;* cashew nut, *Anacardium occidentale;* macadamia, *Macadamia integrifolia.*

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Horsechestnut
Kola nut
Litchi
Macadamia nut
Nutmeg
Pecan
Piñon
Pistachio nut
Walnut

Nutcracker is a bird of the crow family. There are two species of nutcracker, one found in Europe and Asia, and the other in North America. Both are jackdaw-sized birds. The European nutcracker is chestnut brown in colour, with white streaks. The American species, Clark's nutcracker, is pale grey, with black and white wings and tail. Both species nest high in the branches of tall pine trees.

Like many crows, nutcrackers have powerful beaks. As their name suggests, they use these to crack open nuts. They store nuts to get them through the harsh snowy winters. Nutcrackers also open pine cones to get at the seeds. They hold the cones in their heavy claws while opening them.

The European nutcracker inhabits pine forests in southern Scandinavia, and high-altitude coniferous forests in the Alps. It is also found in the mountains of central and eastern Europe, and Asia.

Clark's nutcracker (or *Clark's crow*) inhabits the western pine forests of North America, from Alaska south to Mexico. The female lays from three to five speckled, greyish-green eggs in the nest.

Scientific classification Nutcrackers belong to the crow family, Corvidae. The European nutcracker is *Nucifraga caryocatactes;* Clark's nutcracker is *N. columbiana.*

Nuthatch is a type of climbing bird. There are 21 different species. The birds are found in North America, Europe, North Africa, Asia, and Australia. Nuthatches get their name from their habit of wedging nuts into cracks in tree bark and then *hatching* (opening) them with repeated strokes of the bill.

Most nuthatches live in woodland. They are the only birds which can walk as easily down a tree as up it. They use their large feet and sharp claws for clinging to tree trunks and branches. But unlike woodpeckers, nuthatches do not support themselves with their tails. They have loud, liquid whistling calls and are often easier to hear than to see.

Although many nuthatches eat nuts, they also feed on insects and spiders. In the autumn, they store nuts to feed on over the winter, when live food is scarce.

Most nuthatches nest in holes, either in tree trunks, or, in the case of the rock nuthatch, in rocks. They close up the entrance hole with mud until it is just possible for the birds to squeeze in. The small size of the entrance hole helps to keep out predators.

Typical nuthatches are grey-blue above, with paler orange or buff-coloured undersides. They have a large head with a long, sharp bill. The most widespread species is the *Eurasian nuthatch* which is found in North Africa, throughout Europe, and across Asia to Japan.

In North America, the commonest species is the *white-breasted nuthatch.* It behaves very much like the Eurasian nuthatch, as does the *chestnut-breasted nuthatch,* which is found in the Indian subcontinent.

Red-breasted nuthatch

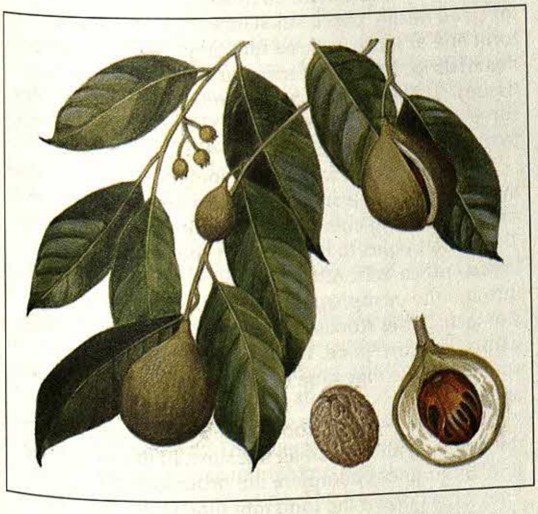
Australia has just one kind of nuthatch, the *varied sitella.* It is grey, black, and white and, like most other nuthatches, is an active woodland bird. The *wall creeper* also belongs to the nuthatch family. It lives at high altitudes in the mountains of Europe and Asia. Unlike true nuthatches, it has a long, curved bill and bright red markings on its wings.

Scientific classification Nuthatches belong to the family Sittidae. The Eurasian nuthatch is *Sitta europaea,* the white-breasted nuthatch, *S. carolinensis,* and the chestnut-breasted nuthatch *S. castanea.* The varied sitella is *Daphoenositta chrysoptera.* The wall creeper is *Tichodroma muraria.*

See also **Bird** (pictures: Birds of North America).

Nutmeg is a tropical tree that is grown commercially for the spice it provides. The spice, also called *nutmeg,* comes from the inner part of the tree's brown seeds. The seeds develop in small fruits that look like golden-yellow pears when ripe. Nutmeg trees are native to the Molucca (Spice) Islands. They are now raised in many countries, including Indonesia, the West Indies, Brazil, India, and Sri Lanka.

The nutmeg tree grows up to 21 metres tall and is an evergreen. It has grey-green leaves that are long and pointed with well-marked veins. The small, pale-yellow flowers droop in clusters and develop into fruit. As the fruit ripens, the fleshy part becomes rather hard. It finally splits open showing a bright-scarlet membrane that partly covers the kernel of the seed. The spice called *mace* comes from this membrane (see **Mace**). Nutmeg is made by grating or grinding the kernels. It has a sweet, spicy flavour.



Nutmeg is the kernel of a tropical fruit that grows on the nutmeg tree. The fruit hangs among shiny, grey-green leaves.

Nutmeg trees do not bear fruit until they are about nine years old. Each tree produces from 1,500 to 2,000 seeds yearly. The fleshy part of the fruit is sometimes preserved and eaten like sweets. A clear oil called *oil of nutmeg* is made from the kernels.

Scientific classification. The nutmeg tree belongs to the nutmeg family, Myristicaceae. It is *Myristica fragrans.*

Nutria, also known as *coypu,* is a large rodent that lives in or near fresh water. Nutrias are native to southern South America, but have been introduced to other countries to be farmed for their fur. The fur is known as "nutria", a corruption of the Spanish word for otter. Nutria fur is used for making coats and gloves, and the meat is used for making pet food.

Nutrias have brown fur, which is thick and soft underneath, with an outer covering of long coarser hair. They have small ears, webbed hind feet, a whitish-tipped muzzle, and a long, scantily haired tail. The tail makes up nearly half of the body length of up to 100 centimetres. Wild nutrias may weigh up to 10 kilograms.

Nutrias are large aquatic rodents that originated in South America. They can weigh up to 9 kilograms.

Nutrias live along the banks of lakes, marshes, ponds, and rivers and spend most of their waking time in the water. They are excellent swimmers and divers and feed chiefly on water plants. Female nutrias give birth to an average of four or five young at a time.

Many nutrias have escaped from fur farms and now breed in the wild. They have become serious pests in some parts of the world, including Europe, East Africa and the southeastern United States. They weaken river and canal banks by burrowing, and upset the ecological balance by consuming large quantities of aquatic vegetation. They also cause damage to rice and sugar cane crops.

Scientific classification The nutria belongs to the family Myocastoridae. It is *Myocastor coypus.*

A balanced diet is the key to good nutrition. It supplies all the food substances the body needs. The family shown above enjoys a breakfast that includes fruit, cereal, bread, and milk. The daily diet should include several servings of these foods.

Nutrition

Nutrition is the science that deals with food and how the body uses it. People, like all living things, need food to live. Food supplies the energy for every action we perform, from reading a book to running a race. Food also provides substances that the body needs to build and repair its tissues and to regulate its organs and systems.

What we eat directly affects our health. A proper diet helps prevent certain illnesses and aids in recovery from others. An improper or inadequate diet increases the risk of various diseases. Eating a balanced diet is the best way to ensure that the body receives all the food substances it needs. Nutrition experts recommend that the daily diet includes a certain number of servings from each of five food groups: (1) vegetables, (2) fruit, (3) breads, cereals, rice, and pasta, (4) milk, yoghurt, and cheese, and (5) meat, poultry, fish, dried beans and peas, eggs, and nuts.

Workers in the field of nutrition coordinate school food services, plan menus for hospitalized patients, and provide nutrition counselling for individuals. They administer international food schemes and investigate the relationship between diet and health. They seek improved ways of processing, packaging, and distributing foods, and they create new foods.

How the body uses food

Food provides certain chemical substances needed for good health. These substances, called *nutrients,* perform one or more of three functions. (1) They provide materials for building, repairing, or maintaining body tissues. (2) They help regulate body processes. (3) They serve as fuel to provide energy. The body needs energy to maintain all its functions.

The body breaks food down into its nutrients through the process of digestion. Digestion begins in the mouth. As food is being chewed, saliva moistens the particles. The saliva begins to break down such starchy foods as bread and cereals. After the food is swallowed, it passes through the *oesophagus,* a tube that leads into the stomach. In the stomach, the food is thoroughly mixed with a digestive juice. The juice, called *gastric juice,* speeds up the digestion of such foods as meat, eggs, and milk.

The partly digested food, called *chyme,* passes from the stomach into the small intestine. In the small intestine, other juices complete the process of digestion. They break down the food into molecules that pass through the walls of the intestine and into the bloodstream.

The blood distributes the nutrients to cells and tissues throughout the body. There the nutrients are broken down to produce energy or are used to rebuild tissues or to regulate chemical processes. Some of the nutrients are stored in the body, and others are used over and over again. But most of the nutrients undergo chemical changes as they are used in the cells and tissues. These chemical changes produce waste products, which go into the bloodstream.

Some of the wastes are carried to the kidneys, which filter the wastes out of the blood. The body expels these wastes in the urine. The liver also filters out some wastes and concentrates them into a liquid called *bile.* Bile is stored in the gall bladder until it is needed to aid in the process of digestion. Then the gall bladder empties bile into the small intestine. From there, any remaining bile passes into the large intestine, along with those parts of the food that could not be digested in the small intestine.

The large intestine absorbs water and small amounts of minerals from this waste material. This material, along with bacteria present in the large intestine, becomes the final waste product, the *faeces,* and it is eliminated from the body.

Kinds of nutrients

The foods we eat contain thousands of different chemicals. However, only a few dozen of these chemicals are absolutely essential to keep us healthy. These few dozen are the nutrients—the substances we must obtain from the foods we consume.

Nutritionists classify nutrients into six main groups: (1) water, (2) carbohydrates, (3) fats, (4) proteins, (5) minerals, and (6) vitamins. The first four groups are called *macronutrients,* because the body needs them in large (or macro) amounts. The last two groups are required in only small quantities and so are known as *micronutrients.*

Water is needed in great amounts because the body consists largely of this substance. Usually, between 50 and 75 per cent of a person's body weight is made up of water.

The body requires large quantities of carbohydrates, fats, and proteins because these nutrients provide energy. The energy in food is measured in units called *calories.* A calorie is the amount of energy required to raise the temperature of one gram of water one degree Celsius. A calorie is equal to 1,000 kilocalories (see **Calorie**).

Although minerals and vitamins are needed in only small amounts, they are as vital to health as any of the other classes of nutrients. Minerals and vitamins are needed for growth and to maintain tissues and regulate body functions.

Water is, perhaps, the most critical nutrient. We can live without other nutrients for several weeks, but we can go without water for only about one week. The body needs water to carry out all of its life processes. Watery solutions help dissolve other nutrients and carry them to all the tissues. The chemical reactions that turn food into energy or tissue-building materials can take place only in a watery solution. The body also needs water to carry away waste products and to cool itself.

Adults should consume about 2.4 litres of water a day. This intake can be in the form of beverages we drink or water in food.

Carbohydrates include all sugars and starches. They serve as the main source of energy for living things. Each gram of carbohydrate provides about 4 calories.

There are two kinds of carbohydrates—*simple* and *complex.* Simple carbohydrates, all of which are sugars, have a simple molecular structure. Complex carbohydrates, which include starches, have a larger and more complicated molecular structure that consists of many simple carbohydrates linked together.

Most foods contain carbohydrates. The main sugar in food is *sucrose,* ordinary white or brown sugar. Another important sugar, *lactose,* is found in milk. *Fructose,* an extremely sweet sugar, comes from most fruit and many vegetables. Foods containing starches include beans, breads, cereals, maize, *pasta* (macaroni, spaghetti, and similar foods made of flour), peas, and potatoes.

Fats are a highly concentrated source of energy. Each gram of fat provides about 9 calories.

All fats are composed of an alcohol called *glycerol* and substances called *fatty acids.* A fatty acid consists of a long chain of carbon atoms, to which hydrogen atoms are attached. There are three types of fatty acids: *saturated, monounsaturated,* and *polyunsaturated.* A saturated fatty acid contains as many hydrogen atoms as its carbon chain can hold. A monounsaturated fatty acid is lacking a pair of hydrogen atoms. In a polyunsaturated fatty acid, the carbon chain contains at least four fewer hydrogen atoms than it could hold.

Certain polyunsaturated fatty acids must be included in the diet because the body cannot manufacture them. These essential fatty acids serve as building blocks for the membranes that make up the outer border of every cell in the body.

Polyunsaturated fatty acids are found in the oils of such plants as sunflowers and sesame seeds and in such fish as salmon and mackerel. Common sources of monounsaturated fatty acids include olives and peanuts. Most saturated fatty acids are contained in foods derived from animals, such as butter, lard, dairy products, and fatty red meats.

Proteins provide energy—like carbohydrates, 4 calories per gram—but more importantly, proteins serve as one of the main building materials of the body. Muscle, skin, cartilage, and hair, for example, are made up largely of proteins. In addition, every cell contains proteins called *enzymes,* which speed up chemical reactions. Cells could not function without these protein enzymes. Proteins also serve as *hormones* (chemical messengers) and as *antibodies* (disease-fighting chemicals).

Proteins are large, complex molecules made up of smaller units called *amino acids.* The body must have a sufficient supply of 20 amino acids. It can manufacture 11 of them in sufficient amounts. Nine others, called *essential amino acids,* either cannot be made by the body or cannot be manufactured in sufficient amounts. They must come from the diet.

The best sources of proteins are cheese, eggs, fish, lean meat, and milk. The proteins in these foods are called *complete proteins* because they contain adequate amounts of all the essential amino acids. Cereal grains, *legumes* (plants of the pea family), nuts, and vegetables also supply proteins. These proteins are called *incomplete proteins* because they lack adequate amounts of one or more of the essential amino acids. However, a combination of two incomplete proteins can provide a complete amino acid mixture. For example, beans and rice are both incomplete proteins, but when they are eaten together they provide the correct balance of amino acids.

Minerals are needed for the growth and maintenance of body structures. They are also needed to maintain the composition of the digestive juices and the fluids that are found in and around the cells. As mentioned earlier, we need only small amounts of minerals in our daily diet.

Unlike vitamins, carbohydrates, fats, and proteins, minerals are *inorganic compounds.* This means that they are not created by living things. Plants obtain minerals from the water or soil, and animals get minerals by eating plants or plant-eating animals. In addition, unlike other nutrients, minerals are not broken down within the body.

The required minerals include calcium, chlorine, magnesium, phosphorus, potassium, sodium, and sulphur. Calcium, magnesium, and phosphorus are essential parts of the bones and teeth. In addition, calcium is necessary for blood clotting. Milk and milk products are the richest sources of calcium. Cereals and meats provide phosphorus. Whole-grain cereals, nuts, legumes, and green, leafy vegetables are good sources of magnesium.

Still other minerals are needed only in extremely tiny amounts. These minerals, called *trace elements,* include chromium, copper, fluorine, iodine, iron, manganese, molybdenum, selenium, and zinc. Iron is an important part of haemoglobin, the oxygen-carrying molecule in red blood cells. Copper helps the body to make use of iron to build haemoglobin. Manganese and zinc are required for the normal action of various protein enzymes. Green leafy vegetables, whole-grain breads and cereals, seafood, liver, and kidney are good sources of most of the trace elements.

Vitamins are essential for good health. Small amounts of these compounds should be supplied daily in the diet. Vitamins regulate chemical reactions by which the body converts food into energy and living tissues. There are 13 vitamins: vitamin A; the vitamin B complex, which is a group of 8 vitamins; and vitamins C, D, E, and K.

Scientists divide vitamins into two general groups, *fat-soluble vitamins* and *water-soluble vitamins.* The fat-soluble vitamins—vitamins A, D, E, and K—dissolve in fats. The vitamins of the B complex and vitamin C dissolve in water.

Vitamin A is necessary for healthy skin and development of the bones. Sources of this vitamin include liver, green and yellow vegetables, and milk.

Vitamin B_1, also called *thiamine,* is necessary for changing starches and sugars into energy. It is found in meat and whole-grain cereals.

Vitamin B_2, or *riboflavin,* is essential for complicated chemical reactions that take place during the body's use of food. Milk, cheese, fish, liver, and green vegetables supply vitamin B_2.

Vitamin B_6 (also called *pyridoxine*), *pantothenic acid,* and *biotin* all play a role in chemical reactions in the body. Many foods contain small amounts of these vitamins.

Vitamin B_{12} and folate (also called *folic acid* or *folacin*) are both needed for forming red blood cells and for a healthy nervous system. Vitamin B_{12} is found in animal products, especially liver. Folate is present in green leafy vegetables.

Niacin is also part of the B complex. Cells need niacin in order to release energy from carbohydrates. Liver, yeast, lean meat, fish, nuts, and legumes contain niacin.

Vitamin C, or *ascorbic acid,* is needed for the maintenance of the ligaments, tendons, and other supportive tissue. It is found in fruit—especially oranges and lemons—and in potatoes.

Vitamin D is necessary for the body's use of calcium. It is present in fish-liver oil and vitamin D-fortified milk. It is also formed when the skin is exposed to sunlight.

Vitamin E, or *tocopherol,* helps maintain cell membranes. Vegetable oils and whole-grain cereals are especially rich in this vitamin. It is also found in small amounts in most meats, fruit, and vegetables.

Vitamin K is necessary for proper clotting of the blood. Green leafy vegetables contain vitamin K. It is also manufactured by bacteria in the intestine.

Nutrition guidelines

Eat a balanced diet. The key to good nutrition is a varied diet that includes every kind of nutrient. To simplify the planning of a varied diet, nutritionists have devised systems that group foods according to nutrient content. One such system divides foods into five groups: (1) vegetables, (2) fruit, (3) breads, cereals, rice, and pasta, (4) milk, yoghurt, and cheese, and (5) meat, poultry, fish, dried beans and peas, eggs, and nuts. The illustration in this article of the basic food groups shows the nutritional value and recommended daily number of servings for each group.

Additional guidelines, called *Recommended Dietary Allowances (RDA's),* are provided in some countries by government agencies to give national nutrition guidelines. RDA's may vary from country to country. The RDA's give health experts' estimates of the amounts of essential nutrients needed daily to maintain good nutrition in healthy people. This article includes a table of RDA's.

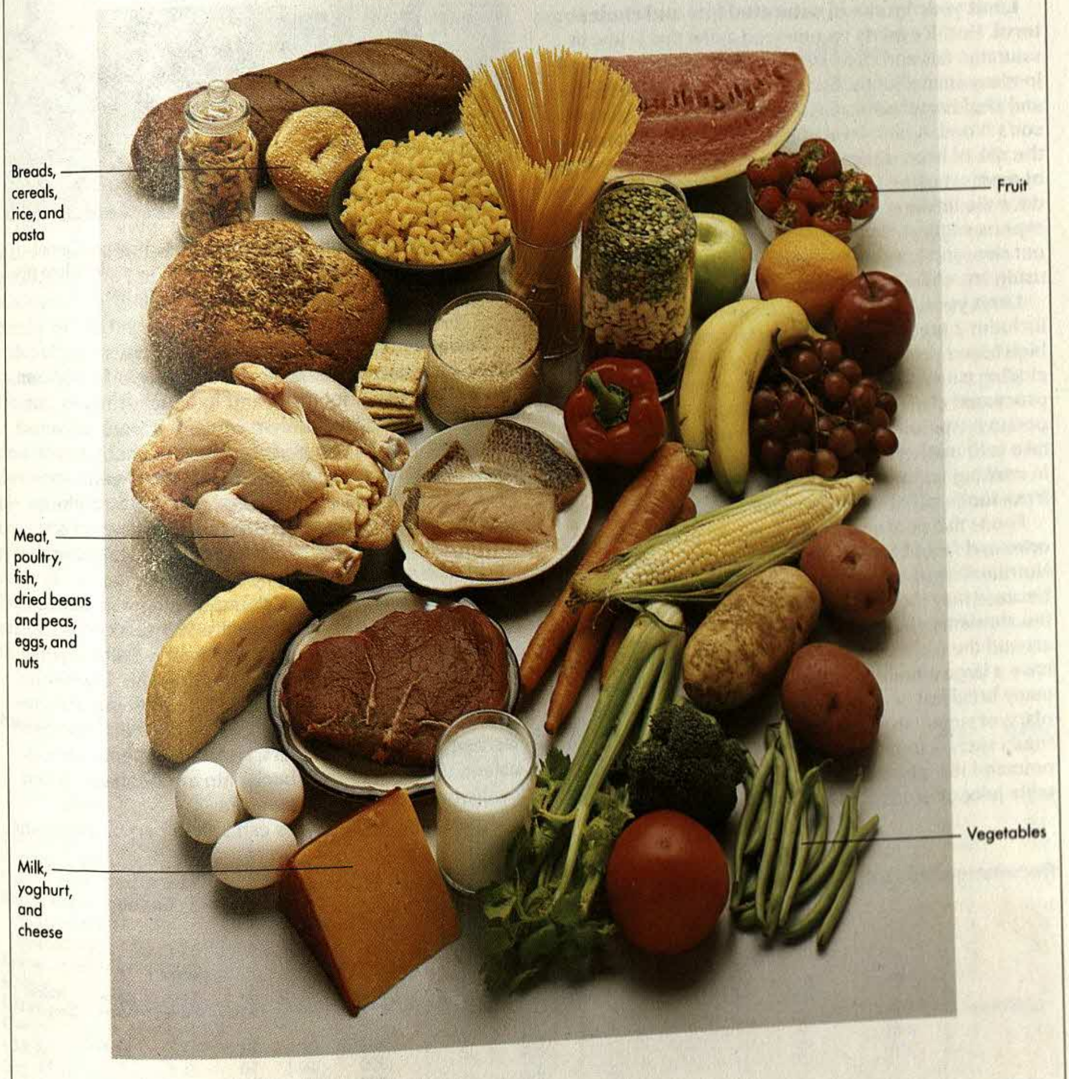
The RDA for a particular nutrient may vary depending on a person's sex and age. The RDA for iron, for example, is 12 milligrams for males age 11 to 18 and 15 milligrams for females age 11 to 50. The RDA for calcium ranges from 400 milligrams for infants under the age of 6 months to 1,200 milligrams for males and females age 11 to 24 and for pregnant women.

People also vary in their needs for energy. A person who plays sports daily, for example, needs more calories than someone who does little physical work. Children need more calories than their size would indicate because they are growing. Pregnant women also need extra calories to provide enough nutrients for a healthy baby.

Include fibre. Dietary fibre consists of cellulose and other complex carbohydrates that cannot be absorbed by the body. It passes out of the body as waste. Fibre moves food along through the stomach and intestines,

Basic food groups

Nutritionists group foods in order to make it easier to plan a balanced diet. They recommend eating a certain number of daily servings of each food group. These servings will provide the proteins, vitamins, and other substances the body needs to function.


Breads, cereals, rice, and pasta
Fruit
Meat, poultry, fish, dried beans and peas, eggs, and nuts
Vegetables
Milk, yoghurt, and cheese

Breads, cereals, rice, and pasta. This group consists largely of carbohydrates, the main source of energy. Nutritionists recommend 6 to 11 servings a day.

Meat, poultry, fish, dried beans and peas, eggs, and nuts. This group is a chief source of proteins. Nutritionists recommend 2 to 3 servings a day.

Milk, yoghurt, and cheese. This group provides vitamin A, vitamin B_2, calcium, and proteins. The recommended daily number of servings is 2 to 3.

Fruit are excellent sources of vitamin C. Fruit also provide dietary fibre. Nutritionists recommend 2 to 4 servings of fruit a day.

Vegetables are excellent sources of vitamin A, the B vitamins, vitamin C, and calcium and iron, as well as fibre. Nutritionists recommend 3 to 5 servings a day.

thus helping to prevent *constipation* (difficulty in emptying the bowels). Many experts believe that it also helps reduce the risk of such rectal and intestinal disorders as haemorrhoids, diverticulitis, and, possibly, cancers of the colon and rectum. Good sources of fibre include whole-grain breads and cereals, beans and peas, vegetables, and fruit.

Limit your intake of saturated fats and cholesterol. Health experts recommend a diet that is low in saturated fats and *cholesterol,* a waxy substance found in many animal foods. Consumption of saturated fats and cholesterol raises the level of cholesterol in a person's blood. A high level of blood cholesterol increases the risk of heart disease. Animal products are the source of most saturated fats and all dietary cholesterol. To reduce the intake of saturated fats and cholesterol, health experts suggest choosing lean meats, fish, poultry without skin, and low-fat dairy products. They also advise using fats and oils sparingly.

Limit your intake of sodium and sugar. A diet that includes a great deal of sodium may increase the risk of high blood pressure. Sodium is found in many foods, including canned vegetables, frozen dinners, pickles, processed cheeses, table salt, and such snack foods as potato crisps and nuts. One way to reduce sodium intake is to use herbs and other seasonings instead of salt in cooking and at the table. Another way is to select fresh foods rather than canned or frozen foods.

Foods that contain a lot of sugar are often high in calories and fat but low in minerals, proteins, and vitamins. Nutritionists sometimes call them "empty calorie" foods, because they may make a person feel full but provide few nutrients. In addition, sugar that remains in and around the teeth contributes to tooth decay. Foods that have a large amount of sugar include sweets, pastries, many breakfast cereals, and sweetened canned fruit. In place of sugary foods, nutritionists advise people to eat foods such as fresh fruit and vegetables. They also recommend that people drink unsweetened fruit and vegetable juices instead of soft drinks.

Obesity may result from poor nutrition. Medical personnel should be consulted to develop and monitor a weight-loss programme involving both diet and physical exercise.

Beware of alcohol. Alcoholic beverages supply calories, but they provide almost no nutrients. In addition, alcohol is a powerful drug, and habitual drinking can lead to many health problems. Health experts recommend that if people choose to drink alcoholic beverages, they consume only small amounts. They suggest that certain people avoid alcohol altogether: children and adolescents, pregnant women, people who are about to drive, people taking certain antibiotics, and those who are unable to limit their drinking.

Don't overeat. When a person consumes more calories than are needed, the body stores most of the excess calories as fat. This can result in *obesity.* An obese person has too much body fat for good health. Obesity increases the risk of such diseases as adult-type diabetes, stroke, high blood pressure, gall bladder disease, heart disease, and certain cancers. Health problems such as osteoarthritis and lower back pain are often worsened by the pressure of excess weight.

A number of techniques can help a person avoid obe-

Recommended daily dietary allowances of some chief nutrients

							Vitamins					
	Age	Weight In kg	Calories	Protein (g)	Calcium (mg)	Iron (mg)	A (mcg R.E.)	C (mg)	D (mcg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg N.E.)
Children	1-3	13	1,300	16	800	10	400	40	10	0.7	0.8	9
	4-6	20	1,800	24	800	10	500	45	10	0.9	1.1	12
	7-10	28	2,000	28	800	10	700	45	10	1.0	1.2	13
Males	11-14	45	2,500	45	1,200	12	1,000	50	10	1.3	1.5	17
	15-18	66	3,000	59	1,200	12	1,000	60	10	1.5	1.8	20
	19-24	72	2,900	58	1,200	10	1,000	60	10	1.5	1.7	19
	25-50	79	2,900	63	800	10	1,000	60	5	1.5	1.7	19
	51+	77	2,300	63	800	10	1,000	60	5	1.2	1.4	15
Females	11-14	46	2,200	46	1,200	15	800	50	10	1.1	1.3	15
	15-18	55	2,200	44	1,200	15	800	60	10	1.1	1.3	15
	19-24	58	2,200	46	1,200	15	800	60	10	1.1	1.3	15
	25-50	63	2,200	50	800	15	800	60	5	1.1	1.3	15
	51+	65	1,900	50	800	10	800	60	5	1.0	1.2	13

kg=kilograms; g=grams; mg=milligrams; mcg=micrograms; R.E.=retinol equivalents; N.E.=niacin equivalents
Above recommendations designed for the maintenance of good nutrition of practically all healthy people.
Source: *Recommended Dietary Allowances,* Tenth Ed., 1989. Food and Nutrition Board, National Academy of Sciences, U.S.A.

sity. For one thing, be careful not to use food as a reward or as a way to overcome loneliness or boredom. It is also a good idea to avoid eating snacks that are high in fat or sugar. Instead, try substituting fruit, fruit juice diluted with water, skimmed milk and unsalted crackers, nonfat yoghurt, and sparkling water. Another way to combat obesity is to be as physically active as possible. Most health experts recommend that a person engage in physical exercise to help reduce weight.

Store and cook foods properly to retain their nutritional value. Many fresh foods should be kept in the refrigerator. They should be washed thoroughly and eaten as soon as possible. Frozen foods must be stored in a freezer. Foods in cans or jars do not need to be refrigerated until after they have been opened.

Vegetables should be cooked quickly and in as little water as possible so that vitamins are not lost in the water. Cooking meats and other animal foods by such methods as broiling, stir-frying, braising, or poaching results in food that is tasty but free of added fat and extra calories. Cooking and reheating by microwave is quick and so helps to retain a high nutrient value in foods.

Be cautious about food myths and misinformation. Often, ideas about foods become popular, but they are not necessarily correct. For example, some people believe that if they take a vitamin pill every day they can eat whatever they choose. But, in fact, people who rely on vitamin pills may not get the amount of calories, minerals, or proteins that they need. Another common, but incorrect, idea is that such starchy foods as potatoes are fattening. In fact, starches provide fewer calories than do such fats as butter or margarine. However, when starches are combined with fats, the combination is high in calories. There is no evidence that gelatin strengthens fingernails, that fish is a brain food, or that celery is a nerve tonic. Eggs with brown shells are not more nutritious than white-shelled eggs. The colour depends on the breed of hen. It is best to use caution and common sense when faced with claims about food products.

Nutrition and disease

An improper or inadequate diet can lead to a number of diseases. On the other hand, good nutritional habits can help prevent certain diseases.

Heart disease in its most common form is called *coronary artery disease* (CAD). CAD narrows the coronary arteries and so reduces the blood supply to the heart. It can lead to crippling attacks of chest pain and, eventually, to life-threatening heart attacks. High blood pressure and high levels of blood cholesterol are two of the major risk factors for CAD. Each of these risk factors can often be lessened by following good practices.

Many people with mild high blood pressure can reduce it by limiting their intake of salt and calories. Similarly, many people can lower their blood cholesterol level by reducing the amount of fat—particularly saturated fat—cholesterol, and calories in their diet. They can do so by avoiding such foods as butter, cakes, biscuits, egg yolks, fatty meats, tropical oils, and whole-fat dairy products.

Cancer. Scientists do not know exactly why cancer develops. But they have found that heredity, environment, and life style all play a role in causing the disease. They have also learned that good nutrition can help pre-

Nutritional values of common foods

Food	Portion	Calories	Protein (g)	Calcium (mg)	Iron (mg)	Vitamin A I.U.	Vitamin C	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Apple, raw	1 large	125	tr.	15	0.4	110	12	0.04	0.03	0.2
Banana, raw	1 large	105	1	7	0.4	90	10	0.05	0.11	0.6
Beans, string, cooked	1 cup	25	2	35	1.2	470	6	0.02	0.08	0.3
Beef, round, cooked										
(lean and fat)	106 g	220	25	5	2.8	tr.	0	0.06	0.21	3.3
(lean only)	99 g	175	25	4	2.7	tr.	0	0.06	0.20	3.0
Bread, white, enriched	1 slice	65	2	32	0.7	tr.	tr.	0.12	0.08	0.9
Butter	1 tablespoon	100	tr.	3	tr.	430	0	tr.	tr.	tr.
Carrots, raw, grated	1 cup	45	1	30	0.6	30,940	10	0.11	0.06	1.0
Cheese, Cheddar	1 ounce	115	7	204	0.2	300	0	0.01	0.11	tr.
Chicken, fried	½ breast	220	31	16	1.2	50	0	0.08	0.13	13.5
Egg, hard-cooked	1 egg	80	6	28	1.0	260	0	0.04	0.14	tr.
Liver, beef, fried	106 g	185	23	9	5.3	30,690	23	0.18	3.52	12.3
Margarine, vitamin-A fortified	1 tablespoon	100	tr.	4	tr.	460	tr.	tr.	0.01	tr.
Milk, whole	1 cup	150	8	291	0.1	310	2	0.09	0.40	0.2
Milk, lowfat	1 cup	120	8	297	0.1	500	2	0.10	0.40	0.2
Oatmeal, cooked	1 cup	145	6	19	1.6	40	0	0.26	0.05	0.3
Orange, whole	1	60	1	52	0.1	270	70	0.11	0.05	0.4
Pork, shoulder, roasted,										
(lean and fat)	106 g	295	23	6	1.4	10	tr.	0.46	0.26	4.4
(lean only)	85 g	165	22	5	1.3	10	tr.	0.40	0.24	4.0
Tomato, raw	1	25	1	9	0.6	1,390	22	0.07	0.06	0.7
Potato, white	1	145	3	8	0.5	0	20	0.16	0.03	2.2
Rice, white, enriched, cooked	1 cup	225	4	21	1.8	0	0	0.23	0.02	2.1
Sugar, white, granulated	1 tablespoon	45	0	tr.	tr.	0	0	0	0	0

g=grams; mg=milligrams; I.U.=International Units; tr.=trace.
Source: *Nutritive Value of Food,* U.S. Dept. of Agriculture.

vent certain kinds of cancer in laboratory animals. Large doses of vitamins A and C have been proven to prevent some cancers in animals. Many scientists believe that certain foods contain substances that may help prevent some cancers in people. Such foods include broccoli, cabbage, carrots, cauliflower, fruit, spinach, whole-grain breads and cereals, and some seafoods. Lessening intake of fats and increasing the intake of fibre may also help prevent some cancers from forming.

Deficiency diseases. Many diseases result from the *deficiency* (lack) of certain nutrients in the diet. When the missing nutrient is provided, the disease usually can be eliminated. Deficiency diseases are most widespread in developing countries, where people often lack access to adequate food supplies. The availability of a variety of foods all year round, along with vitamin and mineral fortification of many foods, have made deficiency diseases less common in most developed countries.

Protein-energy malnutrition, also called *protein-calorie malnutrition,* occurs when the diet is low in both proteins and calories. If the diet is especially low in proteins, the condition is called *kwashiorkor.* Signs of kwashiorkor include changes in the colour and texture of the hair and skin, swelling of the body, and damage to the intestines, liver, and pancreas. The disease, which is common in some developing countries, usually attacks children who are suffering from an infectious disease. Kwashiorkor is fatal unless the patient is given protein along with food providing calories. If the diet is especially low in calories, the condition is called *marasmus.* Marasmus usually attacks infants and young children, and it causes extreme underweight and weakness.

Vitamin deficiencies. The signs and symptoms of vitamin deficiencies vary according to the missing vitamin. Vitamin C deficiency, also called *scurvy,* causes sore and bleeding gums, slow repair of wounds, and painful joints. Vitamin D deficiency, also called *rickets,* causes an abnormal development of the bones. A deficiency of niacin and the amino acid tryptophan, found in protein, causes *pellagra.* The early symptoms of pellagra include weakness, lack of appetite, diarrhoea, and indigestion.

Mineral deficiencies. The most common mineral deficiency disease is *iron-deficiency anaemia,* which results from a lack of iron. In a person with this disease, the blood does not have enough healthy red blood cells and cannot supply the tissues with sufficient oxygen. Thus, the person feels weak or tired. Other symptoms include dizziness, headaches, rapid heartbeat, and shortness of breath. A lack of iodine can cause *goitre,* a disease in which the thyroid gland becomes enlarged.

Food services in schools, nursing homes, and restaurants offer career opportunities in the field of nutrition. The nutritionist pictured above, *left,* directs the preparation of meals.

Other diseases may result from poor nutritional habits. For example, the excessive intake of alcohol causes some forms of liver disease. Obesity increases the risk of gall bladder disease and of diabetes in adults. The risk of *osteoporosis* (loss of bone tissue) is higher for women whose intake of calcium and level of physical activity are low. To prevent osteoporosis, doctors recommend a lifelong combination of regular exercise and a diet with adequate calcium.

Related articles in ***World Book*** include:

Dietary diseases

Allergy
Anaemia
Beriberi
Goitre
Kwashiorkor
Malnutrition
Pellagra
Rickets
Scurvy

Nutrients

Albumin
Amino acid
Carbohydrate
Fat
Gluten
Iron
Lipid
Potassium
Protein
Starch
Sugar
Vitamin

Other related articles

Baby (Feeding procedures)
Biochemistry
Calorie
Cholesterol
Diet
Digestive system
Food
Food preservation
Health
Meat
Metabolism
Rice (Food)
Starvation
Trace elements
Vegetarianism
Weight control
Wheat (Food for people)

Outline

I. How the body uses food
II. Kinds of nutrients
  A. Water
  B. Carbohydrates
  C. Fats
  D. Proteins
  E. Minerals
  F. Vitamins
III. Nutrition guidelines
  A. Eat a balanced diet
  B. Include fibre
  C. Limit your intake of saturated fats and cholesterol
  D. Limit your intake of sodium and sugar
  E. Beware of alcohol
  F. Don't overeat
  G. Store and cook foods properly
  H. Be cautious about food myths and misinformation
IV. Nutrition and disease
  A. Heart disease
  B. Cancer
  C. Deficiency diseases
  D. Other diseases

Questions

Why is water an essential nutrient?
How do complete proteins differ from incomplete proteins?
What are some symptoms of iron-deficiency anaemia?
Why must essential fatty acids be included in the diet?
What is *kwashiorkor*? *Marasmus*?
What are the dangers of obesity?
What are some ways to reduce sodium intake?
What three main functions do nutrients perform?
What are some roles of a registered dietitian?
Why is it important to include fibre in the diet?

Nutritionist. See Nutrition; Food (Food research).

Nutting, Mary Adelaide (1858-1948), was a Canadian-born leader in the development of professional nursing in the United States. She worked to establish professional standards in both the education of nurses and the practice of nursing. She developed several training programmes that supplemented practical experience in a hospital with classroom instruction in nursing principles.

Nutting was born in Waterloo, Quebec. She received a nursing certificate from Johns Hopkins Hospital Training School for Nurses in 1891. She then served as a head nurse at the school until 1894, when she became its principal. Nutting held this position until 1907. That year, when she joined the faculty of Teachers College at Columbia University, Nutting became the world's first professor of nursing. Nutting headed the Department of Nursing and Health at the college from 1910 until she retired in 1925.

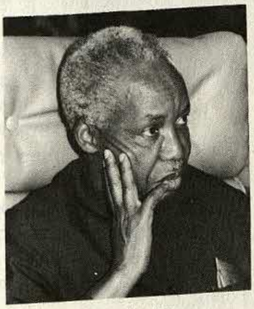
Nyasa, Lake. See **Lake Nyasa.**

Nyasaland. See **Malawi.**

Nye, Bill (1850-1896), was a popular American humorist. He became famous for his clever essays and *anecdotes* (brief stories) on a variety of subjects ranging from the American West to journalism. Nye was also a successful comic lecturer.

Nye was born in Shirley, Maine. His full name was Edgar Wilson Nye. In 1876, Nye moved to Wyoming. He first gained national fame as a columnist for the Laramie *Boomerang,* a newspaper he founded in 1881. In 1886, Nye moved to New York City and wrote humorous columns for the New York *World* newspaper. His books include *Bill Nye's History of the United States* (1894) and *Bill Nye's History of England* (1896). Both were widely popular for their satirical treatment of the past. Nye and the American poet James Whitcomb Riley wrote *Nye and Riley's Railway Guide* (1888), a book of poems and witty prose sketches.

Nyerere, Julius Kambarage (1922-   ), was president of Tanzania from 1964 until he retired in 1985. Tanzania consists of Tanganyika, a region on the African mainland; and Zanzibar, a nearby island group. Tanganyika and Zanzibar were formerly ruled by Great Britain. Nyerere led the movement that resulted in Tanganyika's independence from Britain in 1961. He became the president of Tanganyika in 1962. He also helped unite Tanganyika and Zanzibar to form Tanzania in 1964, and he became the new country's president. He was first elected president in 1965 and was reelected in 1970, 1975, and 1980. Although Nyerere retired as president in 1985, he remained chairman of the only legal political party. As chairman, he is still a major influence in Tanzania.


Julius K. Nyerere

As Tanzania's president, Nyerere became a leading spokesman for cooperation among black African nations. He helped unite Tanzania's many ethnic groups and adopted policies that brought economic progress to the nation. In 1979, Nyerere sent Tanzanian troops to Uganda, after Uganda had invaded Tanzania. The Tanzanian troops helped overthrow the dictatorship of Idi Amin Dada in Uganda.

Nyerere was born near what is now Musoma, Tanzania. He was educated at various schools in what are now Tanzania and Uganda, and at the University of Edinburgh in Scotland.

See also **Tanzania** (History).

Nylon is the general term for a group of synthetic products. These products are made from chemicals derived from coal, water, air, petroleum, agricultural by-products, and natural gas. Nylon is one of the most important chemical discoveries. It is a tough elastic substance that can be formed into fibres, bristles, sheets, rods, and tubes. It also can be made in powdered form for use in moulding operations.

Nylon fibres and fabrics are noted for their strength, ability to be dyed, low shrinkage, silklike appearance, and resistance to abrasion, mildew, and insects. They are not harmed by most kinds of oil and grease or by household cleaning fluids. Nylon fabrics dry rapidly because nylon absorbs little water.

Uses. Nylon is used primarily in fibres and fabrics. Nylon was first made into hosiery, which became available in 1940. It was the first synthetic fabric thought to be superior to natural fabrics. Since then, many uses have been found for nylon. Carpets, tyres, upholstery, dresses, underwear, swimsuits, lace, and parachutes are among the many nylon products.

Nylon is also important in the plastics industry. Nylon plastics are noted for their electrical properties, toughness, and resistance to chemicals, fire, and wear. They are used in such products as electrical equipment, gears, tubing, and sporting equipment. Plastic nylon body panels have replaced steel on some cars.

How nylon is made. Most nylon is made from two chemical compounds— *hexamethylenediamine* and *adipic acid.* Both of these compounds contain carbon and hydrogen. Manufacturers combine the compounds to form *hexamethylene-diammonium-adipate,* commonly called *nylon salt.*

Most nylon factories make the substance by placing a solution of nylon salt in a machine called an *autoclave.* The autoclave heats the solution under pressure. The water is removed, and the molecules that make up each of the compounds combine to form very large molecules. This process of making large molecules from smaller ones is called *polymerization* (see **Polymerization**). In some factories, the newly formed nylon comes out of the machine as a plastic ribbon. The ribbon is cooled, hardened, and cut into chips that are used in making a variety of nylon products. See **Plastics** (How plastics are made).

Nylon fibres are made by forcing molten nylon through tiny holes in a device called a *spinneret.* In some factories, the molten nylon travels to the spinneret as soon as the polymerization process is completed. Other factories melt nylon chips and pump the melted nylon through the spinneret. The streams of nylon harden into filaments when they strike the air. Then they are wound onto bobbins. From 1 to as many as 2,520 filaments are united into a textile nylon yarn.

Nylon fibres are *drawn* (stretched) after they cool. Some factories draw nylon after it has been spun into

Nylon fabric's great strength and other properties make it an ideal material for the manufacture of parachutes.

yarn. Others spin and draw the yarn in one operation. Drawing involves unwinding the yarn or filaments from one spool and winding them onto another. The winding rate is four or more times as fast as the unwinding rate. The pull between the spools stretches the fibres. Drawing makes the molecules in each filament fall into parallel lines. This process gives the fibre strength and elasticity. After being drawn, the yarn may be twisted a few turns per metre as it is wound onto spools. It may also be treated to give it a special texture or added bulk.

The size of nylon yarn is measured in *deniers.* A denier is the weight in grams of 9,000 metres of the yarn. For example, if 9,000 metres of a nylon yarn weigh 15 grams, the yarn is called *15-denier* yarn.

History. Wallace H. Carothers, a chemist of the Du Pont Company in the United States, was a leader in the development of nylon. In the late 1920's, he began to experiment with polymerization. He used a machine called the "molecular still," which made it possible to make longer molecules than had been made before. Carothers found that many of the fibres made from compounds that he polymerized could be pulled out to several times their original length after they were cooled. This pulling process made the fibres much stronger and more elastic.

But most of the compounds that Carothers had made so far melted at a temperature too low to make them practical for textiles that must be ironed. Then, in 1935, Carothers polymerized hexamethylenediamine and adipic acid. The product was called *polyhexamethylene adipamide.* This material had a melting point of 250° C, which is satisfactory for textiles. The new fibre was named nylon and was hailed as a great discovery. Later, chemists referred to this original kind of nylon as *nylon 66* because both chemicals used in making it had six carbon atoms.

Before nylon could be produced for the public market, scientists had to find a way to make large amounts of hexamethylenediamine and adipic acid. Researchers at Du Pont eventually developed a method for making these chemicals from petroleum, natural gas, and agricultural by-products. The production of nylon began in 1938, and the first products were introduced in 1940.

Most manufacturers have continued to produce nylon 66. However, other types of nylon have also been developed. Nylon 6, made from a six-carbon chemical called *caprolactam,* is a major fibre produced in many countries.

Nymph, in entomology. See **Larva.**

Nymph was a lovely maiden of mythology who guarded the different realms of nature. *Oreads* watched over the hills and mountains, and *Nereids* over the Mediterranean Sea. The *naiads* were the nymphs of the rivers, brooks, and streams. The ocean was protected by the *Oceanids.* The *dryads* and *hamadryads* took care of the trees and forests. Many of the naiads watched over springs that were believed to inspire those who drank their waters. The naiads were thought to have powers to prophesy and to inspire people. The oreads were also known by names that came from the particular mountains where they lived.

Nymphs were friendly and kind to mortals. They were shy and fled from human beings, but sometimes they took revenge on people who hurt the things under their protection. Nymphs are represented with fauns and satyrs in the forest, or playing around the keels of ships. Only oreads and naiads were immortal.

See also **Arethusa; Nix.**

Nystagmus is an involuntary, rhythmical movement of the eyes. The eyes may move from side to side, up and down, in a circle, or in a combination of these movements. The motions may be rapid or slow, and jerky or smooth. Nystagmus occurs normally, as when a person watches scenery from a moving train. This condition may also be produced by diseases of the eye, the ear, or the brain. Some people are born with nystagmus.

A type of nystagmus known as *miner's nystagmus* is caused by darkness, and occurs among miners. *Positional nystagmus* occurs only when the patient's head is placed in an abnormal position or level. *Spontaneous ocular nystagmus* occurs as a result of complete blindness or from defective central vision. *Vertical nystagmus* is an up-and-down movement of the eyes. *Latent nystagmus* occurs when one eye is covered.

Nzinga a Nkuwa (? -1506) was the divine ruler of the Kongo kingdom in west-central Africa. His subjects believed he was God in human form.

After the first Portuguese trading ships came to Kongo in 1482, Nzinga a Nkuwa tried to increase his country's trade with Europe. At his request, Portugal sent a number of carpenters, farmers, traders, and other specialists to Kongo. But the Europeans became more interested in developing the slave trade than in aiding the Kongolese.

After Christian missionaries came to Mbanza, Kongo's capital, Nzinga a Nkuwa accepted Christianity as one of the country's religions. He was baptized in 1491 and took the name John I, or *João,* the name of the king of Portugal.

See also **Kongo.**

Oo

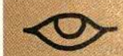
O is the 15th letter in the English alphabet. It also appeared in the alphabet used by the Semites, who once lived in Syria and Palestine. They called the letter *'ayin,* their word for *eye.* For a symbol, they used a stylized picture of an eye. They probably borrowed it from an Egyptian *hieroglyphic,* or picture letter. The Phoenicians borrowed the letter from the Semites. Later, the Greeks borrowed it from the Phoenicians. They called it *omicron.* See **Alphabet.**

Uses. *O* or *o* is about the fourth most frequently used letter in books, newspapers, and other printed material in English. In chemistry, *O* stands for the element *oxygen.* On maps, the letter is the abbreviation for *ocean.* In modern numbering, it represents the *cipher,* or *zero.* In medieval Roman numerals, *O* represented the number 11 and $\overline{O}$, 11,000. It may also be used as the abbreviation for *old, octavo* (a size of book or method of folding a printed sheet), or *ohm* (a unit used in measuring electrical resistance).

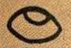
Pronunciation. The letter *o* is a vowel, and has several sounds in English. The main pronunciations are illustrated in the words *November* (long *o*), *not* (short *o*), and *out,* which scholars consider a *diphthong* (combination of short *o* and *u* sounds).

Double *o* also has several sounds in English. When pronounced as a single vowel, the double *o* may have the sounds represented in the words *blood, food, good,* and *hood.* There are a number of words in English in which each *o* is pronounced separately, as in *cooperate* and *coordinate.*

Development of the letter O



The ancient Egyptians, about 3000 B.C., drew this symbol of an eye.



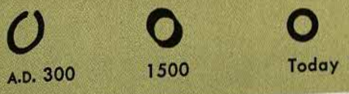
The Semites simplified the Egyptian symbol about 1500 B.C. They named the letter *'ayin,* their word for *eye.*

The Phoenicians, about 1000 B.C., drew the letter as a circle.

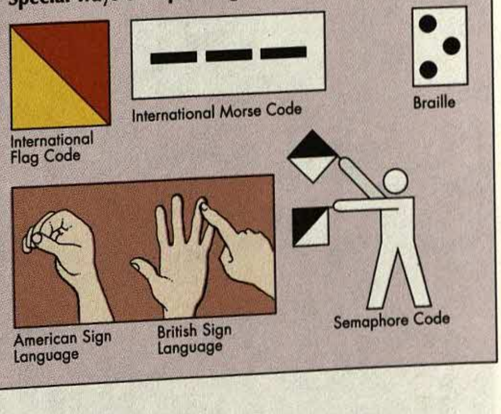
The Greeks borrowed the letter from the Phoenicians about 600 B.C. The Greek letter was called *omicron.*

The Romans, about A.D. 114, gave the letter O this graceful shape.

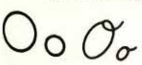
The small letter o first appeared during the A.D. 300's. Its shape changed little through the years.



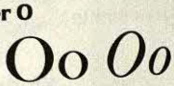
Special ways of expressing the letter O



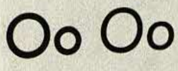
Common forms of the letter O



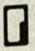
Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.



Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears on the right.



Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears on the right.



Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

Oadby and Wigston (pop. 51,500) is a local government district and borough in Leicestershire, England, containing the former urban districts of Oadby and Wigston. It lies southeast of Leicester, where some residents work. Local industries produce footwear, hosiery, plastics, electrical and engineering goods, printing, and processed foods.

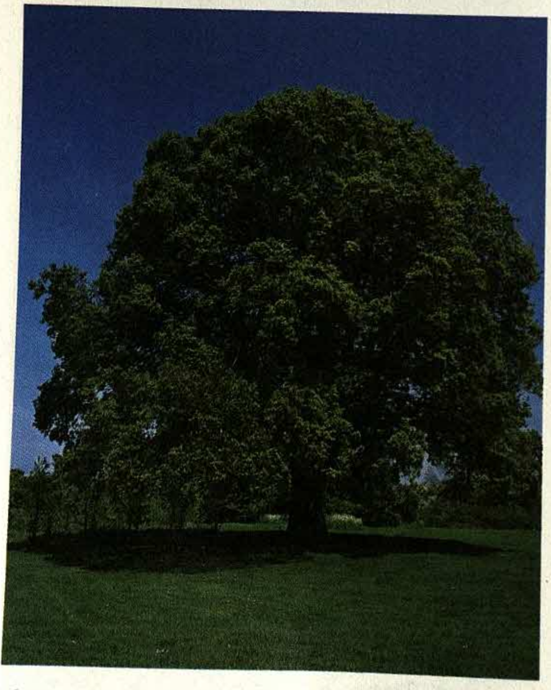
Oahu. See **Hawaii** (Land).

Oak is any of a large variety of trees or shrubs that bear acorns. There are more than 600 species of oaks. Nearly all of them grow naturally in the Northern Hemisphere only. Many trees, especially in Australia, are called "oak" but are unrelated to the oak family.

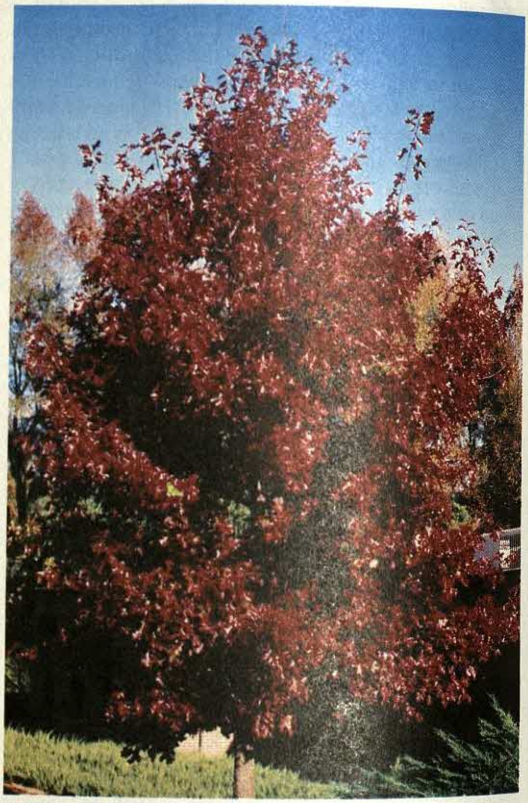
Oaks vary widely in size and in the way they grow. Some oaks never become taller than small shrubs. Others reach heights of more than 30 metres. Many oaks that grow in warm climates do not lose their leaves in the autumn. They are called *evergreens.* But most oaks found in regions with cold winters are *deciduous*—that is, they shed their leaves each autumn. The leaves of many deciduous oaks turn beautiful colours, such as deep red or golden brown, in early autumn.

In the spring, oaks produce small, yellowish-green flowers. The male flowers, which form in dangling clusters called *catkins,* produce large amounts of pollen. The wind carries the pollen to the female flowers and fertilizes them. Once fertilized, a female flower will become an acorn. The acorn is the fruit of the oak. Acorns vary in length from less than 13 millimetres to more than 50 millimetres.

Oaks grow slowly, and usually do not bear acorns until they are about 20 years old. But these trees live a long time. Most oaks live for 200 to 400 years.



The common oak of Europe is also known as pedunculate oak or English oak. The tree above shows the rounded crown of mature specimens.



The scarlet oak of North America is one of the most attractive of the American oaks. Its leaves turn a brilliant red in the autumn. The scarlet oak is a popular shade and ornamental tree.

Uses for oaks

Oaks are an important source of timber. Oak wood is heavy, hard, and strong, and it has a beautiful grain. Manufacturers use it for furniture, barrels, boats, and railway sleepers. Many of the once extensive oak woods of Europe and North America were destroyed long ago to provide timber for boat building and house construction. Cork comes from the bark of some oak *species* (kinds). Acorns are an important source of food for wildlife. In some countries, such as Spain, pigs and poultry are fed on acorns.

Several kinds of oak are used to provide *tannin,* for curing leather, and for making blue-black ink. Tannin is found in the bark of oak trees but is also concentrated in *galls* (small knoblike structures), which appear on the oak leaves. These galls, which are commonly called *"oak apples",* contain the larvae of tiny gall wasps and the plant tissues within them have high concentrations of tannin.

Kinds of oaks

About half of all oak species are native to North America. The *white oak* is one of the commoner North American species. It is widely used for fuel and timber, and its wood makes fine furniture. The *northern red oak* is another American timber tree.

Several of the North American oaks are grown as ornamental trees in other regions. The leaves of the *scarlet oak* and *pin oak* turn bright scarlet in the autumn. The *northern pin oak* has rich crimson autumn leaves.

In northern and central Europe, two oak species are common in mixed deciduous forests. These are the *pedunculate,* and the similar *sessile,* or *durmast, oak.* Both are fine tall trees, with spreading crowns and lobed leaves. They can be identified by the way their acorns grow. The acorns of the pedunculate oak grow on long stalks, whereas those of the sessile oak are attached directly to the twigs. Both trees can grow to more than 35 metres tall and some are known to have lived for more than 800 years.

The *white,* or *downy oak,* can be found in southern and eastern Europe. This species often forms scrub in wine-growing regions, such as mountain foothills in the Mediterranean area. Two other oaks found in southern and southeast Europe are the deciduous *Turkey oak* and *Italian oak.* The *Pyrenean oak* is found in the moister parts of southern and western Europe.

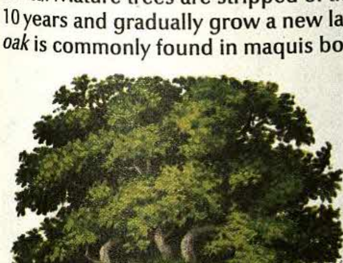
Evergreens are the most dominant oaks in countries with mild winters and warm or hot summers. They have small, leathery leaves, sometimes with sharp hollylike spines to deter grazing animals. Evergreen oaks are often called *live oaks* because they do not have a leafless, dead appearance during the winter. In the Mediterranean region the most important evergreen oaks are the *holm oak* and the *cork oak.* Holm oak once covered much of the lowland in this region but the dark, shady forests have nearly all been cleared to give a low scrub, known as *maquis.* Holm oak is commonly cultivated in parks and gardens for its beautiful grey-green glossy foliage and it grows particularly well in mild coastal areas. Cork oak is found mostly in Spain, Portugal, and North Africa. In Portugal and parts of Spain, it is grown and tended in plantations and its bark provides cork (see **Cork**). Mature trees are stripped of their bark every 8 to 10 years and gradually grow a new layer. The *kermes oak* is commonly found in maquis both in the west and east Mediterranean. It has small, spiny leaves and is the host for a scale insect which has been harvested since medieval times to provide the bright red dye, *cochineal.*

Several oak species grow in the forests of central and eastern Asia. They include the *Japanese* or *Mongolian oak,* an important timber tree. It grows in Japan and also in the far east of the Soviet Union.

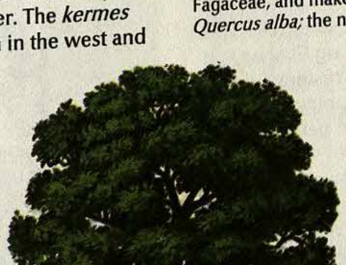
Life of European oakwoods. In oakwoods, there are many other species of trees and shrubs. For example, oakwoods of Europe have understorey shrubs such as hawthorn, hazel, and holly, and a rich field layer of flowering plants. These oakwoods are the original vegetation of much of central and western Europe, and have an extremely rich animal life. Over five hundred species of insects live in these oakwoods, including many leaf-eating (defoliating) caterpillars of small moths and large butterflies such as the purple emperor. The many beetles include chafers and large stag beetles. Insects produce a large number of different types and sizes of galls on oak leaves and other parts of an oak tree. Most galls are caused by small gall wasps which lay their eggs in them. Marble galls are hard, round marble-sized and attached to oak twigs. Oak apples (also found on twigs) are larger than marble galls and are soft and spongy. Spangle galls are tiny reddish domes on the back of leaves. Currant galls hang like redcurrants from male oak catkins. Birds found predominantly in European oakwoods include the greater-spotted woodpecker, nuthatch, pied flycatcher, and tawny owl. Jays and squirrels feed on acorns, and the dormouse is a typical small mammal of the oakwood understorey.

The dwarf oak forests of western United States make up a shrubby woodland called chaparral (see **Chaparral**). Here, *gambel oak* is the dominant species with a matted undergrowth of shrubs. The acorns of the gambel oak provide food for mule deer, pack rats, chipmunks, squirrels, scrub jays, and wild turkeys.

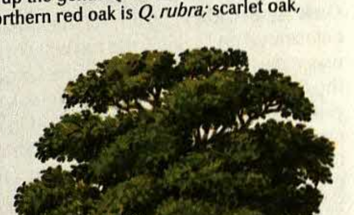
Scientific classification. Oaks belong to the beech family, Fagaceae, and make up the genus *Quercus.* The white oak is *Quercus alba;* the northern red oak is *Q. rubra;* scarlet oak,



The pedunculate oak is named because its acorns grow on long stalks or peduncles. It is native to Britain and northern Europe.



The holm oak has glossy green leaves. It is native to southern Europe and is planted as an ornamental tree in other parts of the world.



The northern red oak is native to the eastern United States and Canada. Like many American oaks, it has pointed leaves.

A European jay feasts on a heavy crop of acorns. Acorns provide food for many species of birds and mammals.

Q. coccinea; pin oak, *Q. palustris;* northern pin oak, *Q. ellipsoidalis;* live oak, *Q. virginiana;* pedunculate oak, *Q. robur;* sessile oak, *Q. petraea;* white oak, *Q. pubescens;* Turkey oak, *Q. cerris;* Italian oak, *Q. frainetto;* Pyrenean oak, *Q. pyrenaica;* holm oak, *Q. ilex;* cork oak, *Q. suber;* kermes oak, *Q. coccifera;* Japanese (Mongolian) oak, *Q. mongolica,* and gambel oak, *Q. gambelii.*

See also **Acorn; Live oak; Tree** (Familiar broadleaf and needleleaf trees [pictures]).

Oak Apple Day, by an Act of Parliament of 1664, was celebrated on May 29, the birthday of King Charles II. It was a day of thanksgiving for the king's restoration to the English throne. Oak trees and oak apples were associated with Charles because he hid in an oak tree to escape Cromwell's troops after the Battle of Worcester. Oak Apple Day is still celebrated in a few places.

Oak Ridge National Laboratory, in Oak Ridge, Tennessee, is one of the largest energy research and development centres in the United States. Work at the laboratory focuses primarily on nuclear energy technology. Oak Ridge researchers conduct experiments with nuclear fission and nuclear fusion. The laboratory is also the major source in the United States for radioactive and stable isotopes used in medicine, industry, and research.

Programmes at Oak Ridge deal with other fields of study in addition to nuclear energy technology. They include research in high-energy physics, metallurgical and solid-state physics, biology, and energy conservation. Scientists at the laboratory also work to develop more efficient methods of using coal and other nonnuclear sources of energy. In addition, scientists study how the use of various forms of energy affects the environment and human health.

Oak Ridge National Laboratory was established in 1943 as part of the World War II Manhattan Project to build the atomic bomb. The laboratory built and operated the *graphite reactor.* This device was the world's first nuclear reactor, and it produced an explosive material used in developing the atomic bomb. Today, Martin Marietta Energy Systems, Incorporated, operates the laboratory under contract with the U.S. Department of Energy. Oak Ridge National Laboratory employs about 5,000 workers.

Oakland, California, U.S.A. (pop. 372,242), is one of the busiest shipping centres in the state. Oakland lies on the eastern shore of the San Francisco Bay. The city lies 4.8 kilometres across the bay from San Francisco.

Oakland was founded after the discovery of gold in California in 1848. The east bay area lay so near San Francisco, the centre of the gold rush, that many prospectors extended their search there. Oakland was named after the oak trees that grew on its hills.

Oakland covers about 210 square kilometres. The Oakland metropolitan area covers 4,206 square kilometres. Lake Merritt lies in the heart of Oakland. Jack London Square includes the bay waterfront that was visited frequently by the author after whom it was named.

Oakland is one of the world's busiest ports for container ships. The city ranks as an important commercial centre. About 25 per cent of workers in Oakland are em-

Annie Oakley became famous as one of the world's most accurate shots with pistol, rifle, and shotgun.

Irrigation ditches filled with water from deep wells or underground springs support date palms and other crops grown on oases, such as this one in western Africa.

ployed in wholesale and retail trade, more than in any other economic activity.

Costanoan Indians lived in what is now the Oakland area before white settlers. Oakland's population grew after trains reached the city from the East in 1869. The Bay Area Rapid Transit system (BART), with headquarters in Oakland, began operating in 1972. A BART train route under San Francisco Bay, between Oakland and San Francisco, opened in 1974. A renewal project called the City Center was begun in the 1970's. This project includes the construction of office buildings and retail outlets, and a new park. The park is to include historic buildings moved from other parts of the city. The City Center project was scheduled for completion in the early 1990's.

Oakley, Annie (1860-1926), was a famous American *sharpshooter* (expert with a rifle) who starred in Buffalo Bill's Wild West show for over 16 years. She was assisted by her husband, Frank Butler, and part of her act was to shoot a coin out of his hand or a cigarette out of his mouth. Oakley also could hit a playing card thrown into the air over 25 metres away from her.

Annie Oakley was born Phoebe Ann Moses in Darke County, Ohio. She learned to shoot at the age of 8 and helped support her family by killing game for a hotel in Cincinnati. At the age of 15, she defeated Butler, a professional marksman, in exhibition shooting in Cincinnati. In 1876, they married. She then adopted the stage name Annie Oakley and took part in shooting exhibitions.

Oakley was only 150 centimetres tall. She was called "Little Sure Shot" by the famous Sioux Indian chief Sitting Bull, who toured briefly with Buffalo Bill's Wild West show. Oakley joined the show in 1885, and Butler became her manager. In 1901, she was injured in a train accident and resigned from the show. She joined a theatrical group and starred in *The Western Girl* (1902). During World War I (1914-1918), she gave shooting exhibitions and instruction to American soldiers.

The popular musical comedy *Annie Get Your Gun* (1946), which features songs by composer Irving Berlin, is loosely based on Oakley's life. It portrays her as an outspoken tomboy. But she was a quiet, simple person who did needlepoint in her spare time.

Oakum is loose fibre obtained by untwisting and picking at old, tarred hemp ropes. The fibre is used mainly to *caulk,* or stuff, the seams of wooden ships to make them watertight. Plumbers use oakum for packing joints in waste pipes. *White oakum,* made from clean rope, was formerly used for medical purposes, such as dressings for wounds.

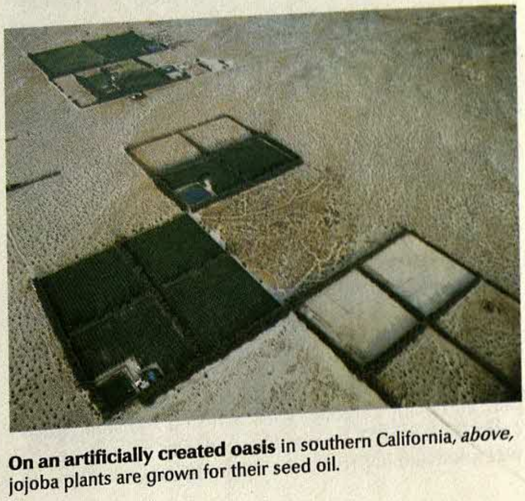
Oar. See **Rowing.**

Oarfish is a large fish that lives in all oceans. It is also known as king-of-the-herrings. It sometimes reaches a length of 11 metres. A long, bright red fin runs the length of the oarfish's silvery body. The oarfish swims with a snakelike, undulating motion.

Scientific classification. The oarfish is in the family Regalecidae. It is *Regalecus glesne.*

See also **Fish** (picture: Fish of the deep ocean).

Oasis is a fertile area with vegetation in a desert where underground water comes close enough to the surface for wells and springs to exist. Water that occurs at an



On an artificially created oasis in southern California, *above,* jojoba plants are grown for their seed oil.

oasis originally fell as rain or snow in distant mountains or hills. After seeping into the ground, the water slowly filters through the underground rocks toward low places in the desert. It then reappears at the surface to form springs or is shallow enough to be found in wells. Areas with vegetation along permanent streams in deserts are sometimes also called oases.

Soil in desert regions is generally fertile but lacks the moisture to encourage plant growth. Because oases have water, almost all of them are areas of farming and settlement. Some oases are small and can support only a few people, but others are large enough to support millions of people.

See also **Africa** (picture: Deserts); **Desert; Merv; Sahara.**

Oates, Joyce Carol (1938-), is an American author. She gives most of her novels and short stories a nightmarish quality by emphasizing sex and violence. However, her real subjects are society and the insanity it generates. Oates has written more than 30 books. Some critics have argued that she would profit from polishing her fiction, but most agree that her imaginative pictures of modern society are accurate.

Oates dramatized the relationship between American society and its people in *A Garden of Earthly Delights* (1967). This novel shows how she believes society treats the poor. *Them* (1969) portrays the violent lives of a poor family in Detroit. *Unholy Loves* (1979) is a comic novel set on an American college campus. *A Bloodsmoor Romance* (1982) satirizes the popular romantic novels of the 1800's.

Many of Oates's characters are mentally ill. For example, in *Expensive People* (1968), a teenager who has difficulty distinguishing reality from fantasy confesses to the murder of his mother. Yet this character may not have committed the crime. The hero of *Wonderland* (1971) and the heroine of *Do With Me What You Will* (1973) have mentally ill fathers.

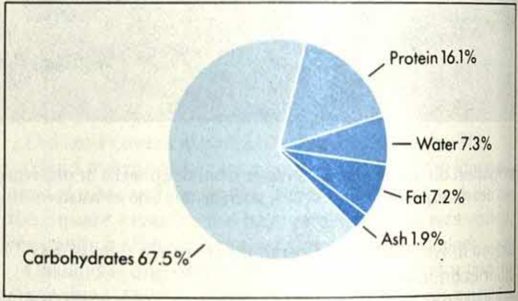
Oates's stories have been collected in *By the North Gate* (1963), *The Wheel of Love* (1970), *Last Days* (1984), and *Raven's Wing* (1986). She has also written scholarly essays, plays, and poetry. Oates was born in Lockport, New York.

Oates, Lawrence Edward Grace (1880-1912), was a British army officer and a member of the British expedition to Antarctica led by Captain Robert Falcon Scott. He joined the expedition in 1910 and in 1912 was a member of the sledging party that reached the South Pole. On the return journey, he was frostbitten and had difficulty in keeping up with the others. In an act of heroic self-sacrifice, Oates walked to his death in a raging blizzard. As he left the tent, he said: "I am going outside; I may be some time."

Oates was born in London. He joined the army and served in South Africa, Egypt, and India.

Oates, Titus (1649-1705), was an English Protestant extremist who, in 1678, made up the story of a plan by Roman Catholics to assassinate King Charles II and destroy Protestantism. Oates claimed knowledge of a conspiracy he called the *Popish Plot,* hatched, he said, by Jesuit priests. Oates became a hero for revealing such a plot, and many Catholics were arrested and some executed. But, in 1685, he was charged with perjury, and was fined and imprisoned. William III released Oates in 1689 and gave him a pension. Oates was born in Oakham, England, in the present-day county of Leicestershire.

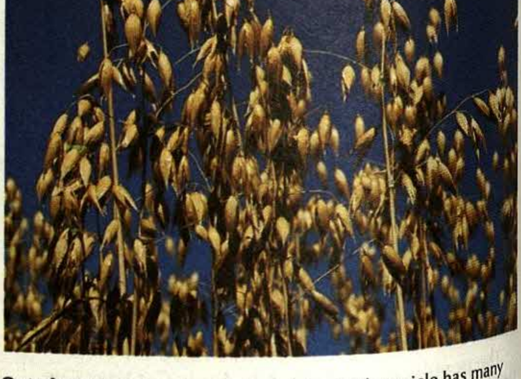
Oatmeal is a food product prepared from oats. It is commonly eaten as a cooked breakfast cereal, called porridge. Oatmeal is made by removing the outer husk of the oat kernel. The *groats,* or inner portion of the kernel, is scoured to remove some of the outer skin. Then it is partially cooked by steaming, and rolled to form flakes. Quick-cooking oatmeal is obtained when groats are cut into smaller particles before being rolled into flakes.



The food value of oatmeal makes it a nourishing breakfast cereal. One cup of oatmeal has about 130 calories.

Oatmeal is a good source of B vitamins and iron. One cup (240 grams) of oatmeal porridge contains about 23 grams of carbohydrates, 5 grams of protein, and 2 grams of fat. One cup is made up of about 85 per cent water and has 130 calories.

Oats are an important grain crop. Farmers grow them mainly to feed livestock, but oats also provide nourishing food for many people. The seeds of oat plants are



Oat plants have heads called *panicles.* Each panicle has many flower clusters called *spikelets,* which contain the seeds. Each seed is enclosed by a hull.

processed and used in such foods as oatmeal, oatcakes, biscuits, and ready-to-eat breakfast cereals.

Oats are a cereal grain and belong to the same family of plants as wheat, rice, maize, and barley. Oats have a higher food value than any other cereal grain. They are rich in starch and high-quality protein, and they provide a good source of Vitamin B_1, also called thiamine.

In many developed countries, a large proportion of the oats grown is used as feed for livestock. Oats are the best grain to feed horses. Many farmers use the straw from oats as bedding for their livestock.

Prior to its breakup, the Soviet Union produced more oats than any other country. The United States was the second largest producer. About 50 million metric tons of oats are grown annually.

The oat plant has a stem that grows from about 60 to 120 centimetres high. The stem ends in a head called a *panicle,* which consists of many small branches. Each branch ends in a single *spikelet* (flower cluster). The majority of oat plants have from 40 to 50 spikelets. Most spikelets contain two seeds, each enclosed by a husk called the *hull.* The hull must be removed before the seeds can be processed into oatmeal or other food products. The oat seed, called a *groat,* is usually the same colour as the hull. Different varieties may be white, yellow, red, grey, or black. Cultivated oats include *common oats, red oats, side oats,* and *hull-less oats.*

Planting oats. Many farmers plant oats with a machine called a *grain drill.* Planting times vary from country to country.

Harvesting oats, a farmer may use a *combine.* This machine cuts down the stalks and separates the grain from them.

Leading oat-producing countries

Tons of oats produced in a year	
Soviet Union*	●●●●●●●●●●●●●●●●●●●●● 16,972,000 metric tons
United States	●●●●● 4,029,000 metric tons
Canada	●●●●◖ 3,349,000 metric tons
Poland	●●◖ 2,176,000 metric tons
West Germany†	●● 1,703,000 metric tons
Sweden	●◖ 1,466,000 metric tons
Finland	●◖ 1,321,000 metric tons
France	●◖ 991,000 metric tons
Argentina	◖ 653,000 metric tons
China	◖ 600,000 metric tons

*Soviet Union figure is for period prior to the country's breakup.
†Germany figure is for period before reunification.
Figures are for a three-year average, 1988-1990.
Source: *FAO Production Yearbook, 1990.* Food and Agriculture Organization of the United Nations.

Growing oats. Oats can be grown in a variety of climates and soils. But they grow especially well in areas that have a cool, moist climate and fertile soil. Farmers may add fertilizer to poor soil to increase the yield.

Farmers grow two types of oats, *spring oats* and *winter oats.* Spring oats are planted in early spring and harvested in summer. The date of planting and harvesting depends on the climate of the area. Winter oats are planted in the autumn and harvested the next summer. They start growing before the weather turns cold. Growth stops in the winter and begins again in spring. Winter oats are not as hardy as other winter grains, and so they are grown chiefly in areas with mild winters.

Oats are planted either by simply scattering the seeds over the field or by sowing the seeds with a *grain drill.* This machine drops the seeds into furrows and covers them with soil.

Harvesting oats. Oats are harvested after the plants become dry and yellow and the seeds harden. The grain should not contain more than 12 to 14 per cent moisture when harvested. Farmers can take samples of the seed to be tested for moisture content.

Some oats are grown for hay or *silage.* Silage consists of chopped plant stalks, which are stored in a silo and used to feed livestock during the winter. Oats grown for hay or silage are harvested while the plants are still green and the seeds are soft.

Most farmers harvest oats with a *combine,* a machine which cuts the stalks and separates the grain from the *chaff* (stiff, strawlike bits surrounding the grain).

Diseases and insect pests. Various diseases sometimes attack the oat plant and sharply reduce the yield. These diseases include smuts, rusts, septoria, and barley yellow dwarf. Oat crops can also be damaged by such insects as aphids, army worms, cutworms, cereal leaf beetles, and grasshoppers. Aphids are especially troublesome because they spread the barley yellow dwarf disease.

Some farmers use chemical sprays to control diseases and insects. But the best protection comes from planting resistant varieties of oats. Researchers continually develop new varieties that are more resistant to diseases and insects. The new varieties also produce higher yields and better grain. See **Smut; Rust; Aphid; Cutworm.**

Scientific classification. Oats belong to the grass family, Gramineae, and to the genus *Avena.* Common oats belong to the species *A. sativa.*

See also **Grain; Oatmeal; Furfural.**

Oaxaca, officially Oaxaca de Juárez (pop. 157,284), is the capital of Oaxaca, a state in southern Mexico. It stands in a rich mining, farming, and forest region (see **Mexico** [political map]). Oaxaca has won fame for handicrafts. The ruins of two ancient Indian cities, Mitla and Monte Albán, lie near Oaxaca. Some historians believe the Aztec founded Oaxaca in 1486. But the Zapotec and the Mixtec Indians had lived in the area since the time of the early Christians. The people of colonial Oaxaca produced impressive architecture.

Ob River, is one of the chief rivers of Russia in Asia. It rises in the Altai Mountains of western Siberia and flows northwestward for 3,650 kilometres before it empties into the Arctic Ocean through the Gulf of Ob (Obskaya Guba). The river drains 2,914,250 square kilometres.

The navigable waterways of the Ob and its tributaries total about 30,600 kilometres. The lower part of the river is 3 to 6 kilometres wide, while the estuary averages 80 kilometres in width. It is blocked with ice from October to June. In summer, the Ob River is an important water route for shipping grain, dairy products, livestock, wool, and meat. Most of this moves to the railways for shipment to the western part of Russia, but some is exported by way of the Arctic Ocean.

Obadiah, Book of, is a book of the Hebrew Bible, or Old Testament, named after an Israelite prophet. The book is the shortest in the Bible, consisting of 21 verses. It was probably composed after the destruction of Jerusalem in 587 or 586 B.C. Its three sections deal with the destruction of Edom (verses 1-9), the misdeeds of Edom against Israel (10-14), and the restoration of Israel at the expense of other nations (15-21). Verses 1-9 closely parallel the Book of Jeremiah (49:7-21), but Obadiah appears to preserve the original form of this prophecy. The author's familiarity with prophetic themes, such as "The Day of the Lord" (15-21), places him in the mainstream of late Biblical prophecy.

See also **Bible** (The Old Testament).

Obelisk is a great, upright, four-sided stone pillar. The sides slope slightly so that the top is smaller than the base. The top is shaped like a pyramid and ends in a point.

Ancient Egyptians erected huge obelisks that were cut from single blocks of granite. Most obelisks had inscriptions in *hieroglyphics* (picture writing). They were often erected in pairs at entrances to temples. Two obelisks, now known as Cleopatra's Needles, were originally at Heliopolis, Egypt. In the 1800's, one was taken to New York City, and the other to London (see **Cleopatra's Needles**). An obelisk from the temple of Luxor, Egypt, is now in Paris' Place de la Concorde.

Obelisks were cut right at the quarry. The ancient Egyptians first made a horizontal, three-sided form by cutting deep trenches all around the form. Then they split away the fourth side either by inserting copper or wooden wedges, or by pounding through the underside with balls of diorite, a hard rock. Finally they polished the obelisk. Still unexplained is exactly how they raised the huge stone pillar to an upright position at its final site.

See also **Paris** (picture: The Place de la Concorde).

Oats, healthy and diseased. The oats on the right have been attacked by powdery mildew fungus. The oats on the left have had genetic material introduced from wild oats, making them resistant to fungus attack.

Oberammergau residents perform the town's famous Passion Play, which portrays the suffering and death of Jesus. The play was first staged in 1634 and is normally presented every 10 years.

Oberammergau (pop. 4,664) is a Bavarian village 72 kilometres southwest of Munich in southern Germany (see **Germany** [political map]). It is famous for its performances of the Passion Play, which normally take place every 10 years. This pageant, which attracts thousands of tourists, portrays the suffering and death of Jesus. Residents perform all the parts. The play was first performed in 1634 (see **Passion Play**).

Oberammergau lies in a valley at the foothills of the Bavarian Alps. Bible scenes cover the outside walls of many of the village's buildings. Some of these painted scenes date back to the 1600's. Many people of Oberammergau produce fine wood carvings. Much of the village's income comes from the tourist trade and the sale of carvings.

Oberth, Hermann. See **Space travel** (Early developments).

Obesity. See **Weight control.**

Objective case. See **Case** (Pronouns).

Oboe is the smallest and highest-pitched of the double-reed woodwinds. The name comes from two French words: *haut,* meaning *high,* and *bois,* meaning *wood.* The oboe is about 53 centimetres long. It was developed in the 1600's, probably by two French musicians, Jean Hotteterre and André Philidor.

The range of the oboe is almost three octaves. The tone is made by means of a small double reed. The oboe is hard to play because so little air is needed to blow it. The player must breathe more slowly than normally. Early oboes produced a loud, harsh tone, but today oboes have a smooth and beautiful sound.

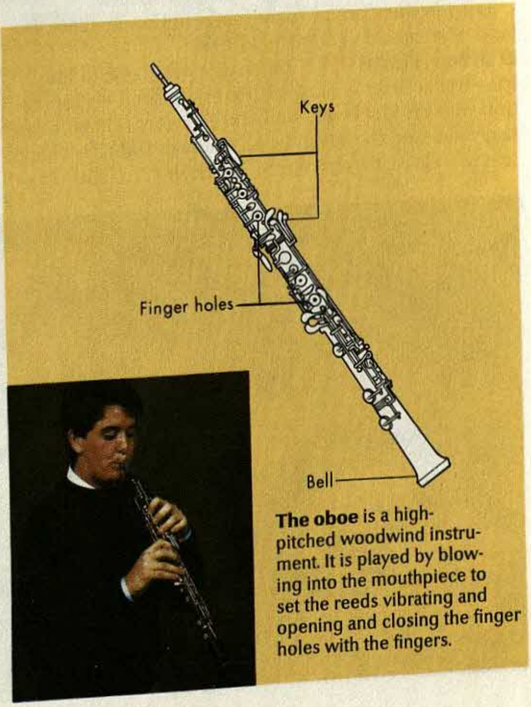
The oboe is important in symphony orchestras, concert bands, and small ensembles. Composers who wrote works for the oboe include Beethoven, Handel, and Mozart. The cor anglais, or English horn, is an alto oboe, a fifth lower in pitch than the oboe.

See also **English horn.**

Obote, Apollo Milton (1926-), served as president of Uganda from 1966 until 1971 and from 1980 until 1985. Obote was born in the Lango district of Uganda. In 1958, he was elected to the Ugandan legislature. In 1960, Obote became leader of the Uganda People's Congress, a new political party he had helped create. He led Uganda, then a British protectorate, to independence in 1962. He then served as the first prime minister of the nation. In 1966, Obote seized full control of the government and declared himself president. The people elected him president in 1967.

As president, Obote abolished the country's separate local kingdoms and ruled with absolute power. He put industry under government control. A military revolt overthrew Obote in 1971, and he went into exile. Idi Amin Dada, who led the revolt, then ruled Uganda until 1979, when he was overthrown. In 1980, Obote returned to Uganda and was elected president again. But tensions arose between the Langi tribe, to which Obote belonged, and the Acholi, who formed the tribal majority in Uganda's national army. As a result of this, military leaders again overthrew Obote in 1985, and he was forced into exile for a second time.

See also **Uganda** (History).



The oboe is a high-pitched woodwind instrument. It is played by blowing into the mouthpiece to set the reeds vibrating and opening and closing the finger holes with the fingers.

Obregón, Álvaro (1880-1928), a Mexican soldier, statesman, and rancher, succeeded Venustiano Carranza as president of Mexico, in 1920 (see **Carranza, Venustiano**). Obregón was one of the most capable leaders of the Mexican Revolution. He was reelected president in 1928 but was assassinated before he could take office.

In 1912, during a revolution against the government of President Francisco Madero, Obregón raised a force of Sonora Indians and went to Madero's aid. In 1913, Victoriano Huerta murdered Madero and seized the presidency. Obregón joined Venustiano Carranza against Huerta. In 1914 and 1915, Obregón supported Carranza against Pancho Villa (see **Villa, Pancho** [with picture]). In his battles with Villa, Obregón used barbed-wire entanglements, machine-gun nests, and trench warfare for the first time in Mexico. He was born in the Alamos district of Sonora.

See also **Mexico** (Economic and social changes).

O'Brien, Conor Cruise (1917-), an Irish diplomat and writer, became a member of Seanad Éireann in 1977 but resigned his seat in June 1979. He had been a Labour member of Dáil Éireann from 1969 to 1977, and served as Minister of Posts and Telegraphs from 1973 to 1977.

O'Brien was educated at Trinity College, Dublin. He served in the Department for External Affairs and, in 1961, was the representative of the United Nations Secretary General in Katanga, in what is now Zaire. In 1962, he published *To Katanga and Back.* In 1977, after losing his seat in the Dáil and resigning from the Irish parliamentary Labour Party, he became editor of *The Observer.* He retained this post till 1981.

O'Brien, Edna (1932-), an Irish novelist, established her reputation with her first novel, *The Country Girls,* published in 1961. Her other works include *The Lonely Girl* (1962), *Girls in Their Married Bliss* (1963), and *The Love Object* (1968). She has also written several short stories, television plays, and film scripts.

O'Brien was born at Tuamgraney in County Clare, Ireland. She moved to England in 1958.

O'Brien, Flann (1912-1966) was a pen name of the Irish writer Brian O Nuallain. He established his reputation with his first novel, *At Swim Two Birds* (1939), a fantasy following the adventures of human and fairy characters in Ireland. He also wrote *The Hard Life* (1961), *The Dalkey Archives* (1965), and a play, *Faustus Kelly* (1943). Under the pen name Myles na gCopaleen, he wrote satirical columns for the *Irish Times.* He was born in Strabane, in Ulster, and worked as a civil servant.

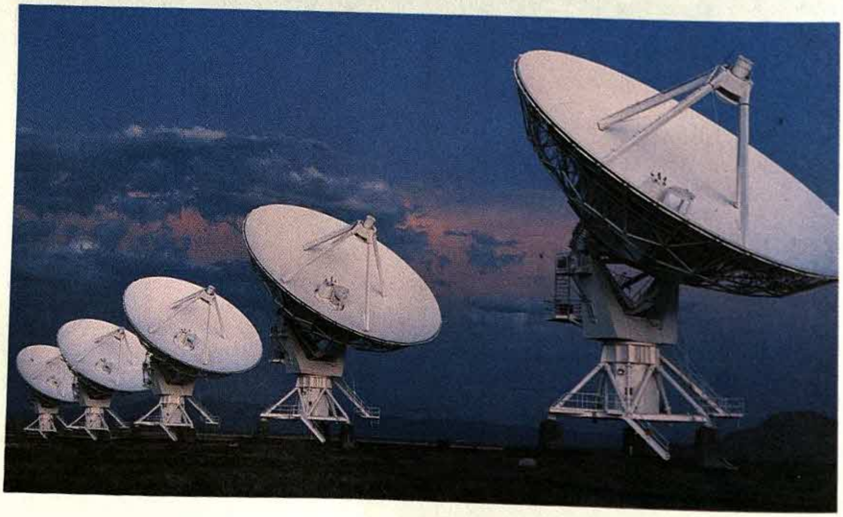
O'Brien, William Smith (1803-1864), represented Ireland in the British House of Commons. In 1848, he organized an unsuccessful rebellion. He was sentenced to transportation for life to Van Diemen's Land (now Tasmania). From Maria Island, he made an unsuccessful attempt to escape on an American whaler. Later, he was transferred to Port Arthur and was allowed his own cottage. He settled at New Norfolk. Later, he moved to Avoca, where he acted as a tutor. In 1854, he was granted a conditional pardon and returned to Europe.

Obscenity and pornography are terms used to designate written, recorded, or pictorial material—including films—that many people consider indecent and thus find offensive. The term *obscenity* can also refer to language or to behaviour believed to corrupt public morals. The term *pornography* refers chiefly to printed or sexually explicit pictorial material intended primarily to cause sexual stimulation. Some people use the term to refer to printed or pictorial material that glorifies violence against women or degrades women. In many cases, however, the terms *obscenity* and *pornography* are used interchangeably.

Many nations have antiobscenity laws. In some countries such as Ireland and Italy, these laws are strictly enforced. In Canada, antiobscenity groups have fought for years for stricter laws and stricter enforcement. Many members of these groups seek recognition of the harm resulting from materials that endorse sexual violence against women. But some nations have repealed their obscenity laws or are considering doing so. In the late 1960's, for example, Denmark dropped all legal barriers against pornography for adults.

See also **Censorship.**

Observatory is a building or an institution where astronomers study the sun, planets, stars, and other objects in the universe. These scientists examine the various forms of *radiation* (energy) in space, including light, radio waves, and X rays. Astronomers also study how atoms behave in the vast spaces among the stars and in the high temperatures of the stars themselves.



A radio interferometer is made up of several telescopes linked so they observe the same object at the same time. The signals from each telescope are processed and combined to produce a single image much more detailed than that produced by even the most powerful single telescope.

The Kitt Peak National Observatory, *above,* stands on a high mountain near Tucson, Arizona. Its location, away from bright city lights and free of polluted air and violent atmospheric disturbances, provides astronomers with excellent observing conditions.

There are two chief kinds of observatories. *Optical observatories* have optical telescopes for the study of light. *Radio observatories* have radio telescopes for the study of radio waves. Optical telescopes use such devices as lenses and mirrors to form magnified images of distant objects. Most radio telescopes use large antennas to capture radio waves from space. Observatories also have such instruments as cameras and electronic sensors to record information gathered by optical and radio telescopes. In most cases, computers guide the telescopes and analyse the data they collect.

Astronomers build observatories in places that have good observing conditions, free of such difficulties as those caused by violent atmospheric disturbances, polluted air, and bright lights. Most optical observatories stand on high mountains, where the sky is almost always clear. Many radio observatories are in valleys, where the mountains protect them from radio interference from cities and other highly populated areas.

Most observatories are operated by universities and are used by teachers and advanced students of astronomy. They are extremely expensive to build and operate, and so national governments or wealthy individuals support many of them.

Optical observatories. The telescope in an optical observatory stands under a large dome that has shutters. The dome and the shutters protect the telescope from the weather. Motors and precision gears keep the telescope pointed in the desired direction as the earth rotates. Observatories use two principal kinds of optical telescopes—*reflecting telescopes* and *refracting telescopes.* Reflecting telescopes use a curved mirror or a set of such mirrors to focus light, and refracting telescopes use a system of lenses.

Most optical observatories use reflecting telescopes, which can be made larger than refracting telescopes. The Hale telescope at the Palomar Observatory near San Diego, California, U.S.A., ranks as one of the world's largest reflecting telescopes. Its mirror measures 510 centimetres in diameter.

Refracting telescopes need large lenses of high quality. Such lenses are difficult to make, and they absorb much of the light that they gather. The refracting telescope at the Yerkes Observatory in Williams Bay, Wisconsin, U.S.A., is the world's largest. Its lens measures 100 centimetres in diameter.

Many of the images produced by optical telescopes are too dim to be seen directly. As a result, astronomers rarely make observations by looking through a telescope. They use photographic plates to make pictures of the dim images produced by the telescope. If a photographic plate is exposed to dim light for a long time, a bright image results. Astronomers use electronic imaging devices to study extremely faint objects. See **Telescope.**

Astronomers in optical observatories use an instrument called a *spectrograph* to separate the various colours that make up starlight. A spectrograph, which may be used with a telescope, spreads out starlight into a *spectrum (band of colours).* Scientists can determine the composition of a star from this spectrum. A *photoelectric photometer* is used to measure a star's brightness. It has filters that enable it to work with one colour of light at a time.

Scientists at *solar observatories,* a type of optical observatory, specialize in studying the sun. Such observatories must make special provisions to reduce the effects of the sun's heat. This heat creates currents of hot air near the surface of the earth that blur photographs of the sun. Most solar observatories stand on high towers to escape the effects of the hot air.

Radio observatories. The radio telescopes used by most radio observatories consist of a large bowl-shaped *reflector* that collects radio waves. A radio receiver picks up and amplifies the radio signals that enter the reflector. Scientists study these signals to determine the temperature and composition of various objects in space that give off radio waves.

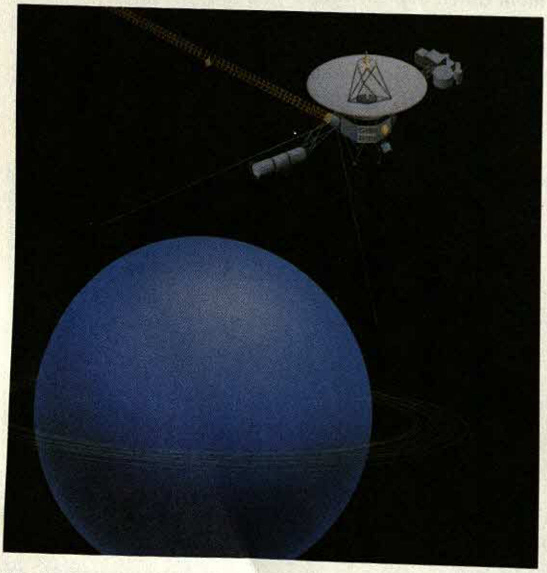
The reflectors of radio telescopes are much larger than the lenses or mirrors of optical telescopes. As a result, radio telescopes can study objects too far away to be seen by optical telescopes. The Arecibo Observatory

Some important observatories

Name	Location	Year opened	Interesting facts
Arecibo Observatory	Arecibo, Puerto Rico	1963	Has the world's largest radio telescope, with a reflector 305 metres in diameter
Australian National Radio Astronomy Observatory	Parkes, New South Wales, Australia	1961	Includes a 64-metre radio telescope used to pinpoint the first quasars
Cape of Good Hope Royal Observatory	Cape Town, South Africa	1820	One of the leading observatories in the Southern Hemisphere
Cerro Tololo Inter-American Observatory	La Serena, Chile	1963	Has the largest reflecting optical telescope in the Southern Hemisphere, with a mirror 400 centimetres in diameter
Jodrell Bank Observatory	Jodrell Bank, England, near Manchester	1949	Includes the world's first radio telescope capable of being pointed in any direction
National Radio Astronomy Observatory's Very Large Array Telescope Project	Socorro, New Mexico, U.S.A.	1980	Has the world's most powerful radio telescope, made up of 27 reflectors, each 25 metres in diameter
Palomar Observatory	Palomar Mountain, California, U.S.A.	1948	Has the largest reflecting optical telescope in the United States, with a mirror 508 centimetres in diameter
Paris Observatory	Meudon, France	1670	Observatory where the speed of light was first measured
Pulkovo Observatory	St. Petersburg, Russia	1839	Site of telescopic observations leading to major advances in understanding the earth's motion
Special Astrophysical Observatory	Zelenchukskaya, near Cherkessk, Russia	1974	Has the world's largest reflecting optical telescope, with a mirror 600 centimetres in diameter
Yerkes Observatory	Williams Bay, Wisconsin, U.S.A.	1897	Has the world's largest refracting telescope, with a lens 102 centimetres in diameter

in Arecibo, Puerto Rico, has the world's largest radio telescope. This telescope has a reflector 300 metres in diameter.

Two or more radio telescopes can be connected to form a *radio interferometer.* A radio interferometer produces clearer images than a single radio telescope. An extremely powerful interferometer radio telescope called the Very Large Array (VLA) is operated by the National Radio Astronomy Observatory. The VLA, located near Socorro, New Mexico, U.S.A., consists of 27 reflectors, each measuring 25 metres in diameter. The most detailed radio images are produced by very long baseline interferometry. This system consists of many telescopes that record signals at the same time from a number of locations. These signals are then sent to a computer and combined into a single high-quality image.



The *Voyager 2* astronomical observatory was launched in 1977 and flew by Uranus in 1986. It transmitted important new information about the planet's rings, moons, and atmosphere.

History. In ancient times, people built observatories to study the positions of the sun, the moon, and the stars. Stonehenge, in Wiltshire, England, is the oldest known structure once used as an observatory. This arrangement of stone slabs is believed to have been built between 2800 B.C. and 1500 B.C. By about A.D. 300, Maya Indian astronomers in Central America had developed an accurate calendar based on observations of objects in the sky.

During the 1670's, observatories began to use refracting telescopes. These telescopes enabled astronomers to determine the positions of objects in space more accurately than ever before. In 1675, King Charles II of England founded the Royal Greenwich Observatory in Greenwich. This observatory provided charts that gave the exact locations of various stars for sailors to follow in navigation.

Many new scientific instruments came into use in observatories during the 1800's. With them, astronomers could study the composition of the stars for the first time. For example, scientists began using spectrographs in the mid-1800's. The photographic plate became one of the chief tools of observatories by the late 1800's.

During the 1900's, most large optical observatories began to use reflecting telescopes. Astronomers developed radio telescopes in the mid-1900's.

In the 1960's, scientists began to place observatories in space to measure gamma rays, ultraviolet light, and X rays. Such radiation is absorbed by the earth's atmosphere. The Hubble Space Telescope, launched in 1990,

A supernova, or exploding star, throws debris over huge distances in space. This photograph, taken by the Hubble Space Telescope, uses false colours to monitor the explosion.

orbits the earth above the atmosphere. This reflecting telescope thereby escapes the blurring effect of the earth's atmosphere. In addition, it can detect ultraviolet radiation blocked by the atmosphere. However, flaws in a mirror have prevented the telescope from producing very sharp images. The Hubble telescope and other orbiting observatories are operated by radio remote control. But scientists do not expect to use radio commands to repair the telescope. Instead, they expect to send a crew of astronauts to make adjustments to the telescope.

Related articles in *World Book* include:

Astronomy
Greenwich Observatory, Royal
Jodrell Bank Observatory
Hubble Space Telescope
Lick Observatory
Mount Wilson Observatory
National Optical Astronomy Observatories
National Radio Astronomy Observatory
Palomar Observatory
Radio telescope
Space travel (Scientific satellites)
Stonehenge
Telescope
Yerkes Observatory

Obsidian is a natural glass formed when hot lava flows onto the surface of the earth and cools quickly. Obsidian has the same chemical composition as granite, but is quenched to make glass rather than cooled slowly to form crystals. Most obsidian is black, or black with red bands. It is brittle and breaks into conelike shapes, but it cannot be quarried in blocks. American Indians used it to make arrowheads and knives.

See also **Granite; Igneous rock.**

Obstetrics and gynaecology are related fields of female medical care. *Obstetrics* is concerned with pregnancy, childbirth, and the six-week period following delivery. Doctors who practise obstetrics are called *obstetricians. Gynaecology* deals with diseases of the female reproductive organs. Doctors who practise gynaecology are called *gynaecologists.* Many doctors specialize in obstetrics and gynaecology.

During a woman's pregnancy, an obstetrician is responsible for the health of both the mother and the *fetus* (unborn child). The obstetrician must take special care to avoid harming the fetus when treating problems in the mother. During childbirth, the obstetrician helps deliver the baby. Thereafter, the obstetrician examines the mother periodically to make sure she recovers from the changes that occurred in her body during pregnancy.

A gynaecologist deals with disorders involving the uterus, the ovaries, the Fallopian tubes, and other organs of the female reproductive system. Such disorders may be present at birth, or they may result from infections, tumours, injuries, or improper balances of *hormones* (body chemicals). The gynaecologist may use drugs or else may need to perform surgery to treat the patient.

See also **Childbirth; Infertility; Pregnancy.**

Ocarina

Ocarina is a small toy wind instrument of the whistle type. It is made of moulded clay or plastic, and shaped like a goose egg. Its name is a form of the Italian word for goose. The ocarina has a mouthpiece by which the player makes his or her breath vibrate within the instrument, and 8 to 10 holes for playing a simple scale. Its tone is pleasing and soft. An Italian named Donati developed the ocarina in the 1860's, but forms of the ocarina were known in ancient China.

O'Casey, Sean (1880-1964), was perhaps the greatest Irish playwright of his time. Born in the Dublin slums and largely self-educated, he gained fame when Dublin's Abbey Theatre staged three of his plays—*The Shadow of a Gunman* (1923), *Juno and the Paycock* (1924), and *The Plough and the Stars* (1926). Each play deals with the violence that Ireland experienced from 1916 to 1924, during and after its fight for independence from Britain. Through these plays, O'Casey shows egotism, slogans, and abstract ideals such as patriotism as the enemies of life and happiness. The plays are full of colourful characters and speech, and are written in a vivid, realistic style.

O'Casey left Ireland for England in 1926, after *The Plough and the Stars* provoked rioting during its opening week. Some of the audience thought the play slandered Ireland's patriots and womanhood. O'Casey broke with the Abbey Theatre in 1928 after it refused to stage his play *The Silver Tassie.* Like his earlier work, this play was antiwar in tone, and shows war as the destroyer of individuality and heroism. The play also developed expressionistic tendencies found in O'Casey's earlier work. Symbolism and expressionism became more important in O'Casey's later plays, especially the ones dating from the late 1940's and 1950's.

Most of the plays O'Casey wrote during the 1930's and early 1940's have revolutionary heroes and call for a radical transformation of society. The dramatic works of this period include *Purple Dust* (1940) and *Red Roses for Me* (1942).

O'Casey returned to Irish themes late in his career. He presented an Ireland that had exchanged British domination for domination by the Roman Catholic Church of Ireland and the new commercial class. Plays of this period include *Cock-a-doodle Dandy* (1949), *The Bishop's Bonfire* (1955), and *The Drums of Father Ned* (1958). O'Casey's most important nondramatic writings are his six volumes of autobiography produced between 1939 and 1956. These volumes were brought together into one publication which first appeared in the United States in 1956 under the title *Mirror in My House.* It is a vivid and colourful picture of O'Casey's life and of Dublin in the early 1900's.

Occam, William of. See William of Ockham.

Occultism is a term that refers to a wide range of beliefs and practices involving magic or forces outside the natural world. Occultism includes astrology, fortunetelling, magic, and *spiritualism*—the belief that spirits of the dead communicate with the living. People who believe in occultism consider it to be based on hidden knowledge that ordinary individuals do not have.

Most scientists reject all occult practices. Others believe in mind reading and certain other occult powers, which they call *paranormal* (outside normal awareness). Opinion regarding some practices has changed through the years. Until the late 1800's, for example, most scientists considered hypnotism an occult practice. However, many scientists accept hypnotism today and use it in medicine and psychology.

Belief in occultism is most common in isolated, nonindustrial societies. But since the mid-1900's, there has been a widespread revival of occultism in the Western world.

Related articles in *World Book* include:

Alchemy
Astrology
Clairvoyance
Divination
Ectoplasm
Extrasensory perception
Fortunetelling
Graphology
Hypnotism
Magic
Mind reading
Numerology
Ouija board
Palmistry
Parapsychology
Phrenology
Psychical research
Spiritualism
Superstition
Telepathy
Witchcraft

Occupancy is a legal method by which a person or nation acquires title to something that no one else owns. Occupancy was first recognized by the civil law of ancient Rome. It later became part of English common law.

To gain title to a thing by occupancy, a person or nation must take possession of the thing with the intention of keeping it. In some places, a person who captures a wild animal and keeps it may become the animal's owner. British settlers claimed Bermuda for Great Britain by occupancy in 1609, when the islands had no other inhabitants.

Occupational disease. See Disease (Environmental and occupational diseases).

Occupational therapy is the use of practical activities to treat physical or mental disabilities. Doctors often prescribe this kind of treatment for people affected by an injury, illness, or emotional problem, or by aging. Occupational therapy focuses chiefly on helping patients develop skills needed to perform specific tasks. For example, patients who use a wheelchair might be taught how to get around in the kitchen and cook meals from a seated position. In this way, they gain confidence in their ability to lead a normal life. Blind people who learn to clothe, feed, and care for themselves are better prepared to live a useful life. Sometimes patients must relearn such basic skills as dressing, writing, or eating. Occupational therapy is often described as "curing by doing" because the patients themselves carry out the activities.

Activities used in occupational therapy are planned and supervised by professionals called *occupational therapists.* These specialists may be assisted by *occupational therapy assistants.* Occupational therapists work in hospitals, rehabilitation centres, mental health centres, schools, nursing homes, and day-care centres. The therapists may also treat patients at home.

Occupational therapists determine what kind of treatment will best help patients. The therapist first must become familiar with a patient's interests and background, and the cause of the patient's disability. The therapist uses this information to plan a programme of activities.

How occupational therapy helps patients

Occupational therapy has two chief goals. These goals are (1) to help physically disabled people use their bodies more effectively and (2) to help mentally disabled people overcome emotional problems.

Helping the physically disabled. People who suffer

Occupational therapy may involve the use of games or other physical activities that help disabled children strengthen their muscles and improve coordination.

A specially equipped car makes it possible for disabled people to drive. In this photograph, a patient manoeuvres himself from a wheelchair into such a car with the help of an occupational therapist.

a serious injury or illness may lose strength and coordination in a part of the body. For example, a person with multiple sclerosis may lose the use of some muscles because the disease damages nerves that control muscles. The occupational therapist then provides activities that restore muscle strength and usefulness. An activity such as woodworking helps build up the patient's arm muscles. The patient can strengthen leg muscles by operating a potter's wheel, using a kicking motion on the pedal. In addition to providing activities, the occupational therapist may make a splint for the patient's hand, arm, or leg to prevent weakened muscles from stretching or shrinking.

Sometimes a disease cripples the body so severely that the patient cannot regain use of certain muscles. The occupational therapist must then teach the patient new ways to perform familiar tasks. Some patients might learn to dress and eat with one hand instead of two. Others might need to develop strong arm and shoulder muscles to operate crutches or a wheelchair.

Occupational therapy plays a vital part in helping people with permanent disabilities, such as blindness or the loss of a limb. Patients learn that they can do things in spite of their handicaps. A blind person might learn to shop or cook alone. An amputee might learn to drive a specially equipped car.

Doctors often prescribe occupational therapy for children who have cerebral palsy. This disorder damages the brain and affects muscular control. A child with cerebral palsy may have difficulty dressing. The occupational therapist might devise a game that involves doing and undoing zips and buttons. This activity helps the child practise the movements of dressing. Some children grow and develop more slowly than others. Such youngsters may receive occupational therapy as part of their school programme. The therapist then works with family members and teachers to provide the child with activities that promote normal growth and development. These activities might include ball games or skipping.

Helping the mentally disabled. Occupational therapists also work with people who have mental disabilities. Some mental disabilities result from emotional disorders, including anxiety, depression, and neurosis. Such problems can interfere with the person's ability to function normally. A person who suffers from depression may find it difficult to manage daily activities. The occupational therapist works with this person to help the person accomplish everyday tasks. For example, a schedule that helps the person plan activities for the day might be one goal of occupational therapy.

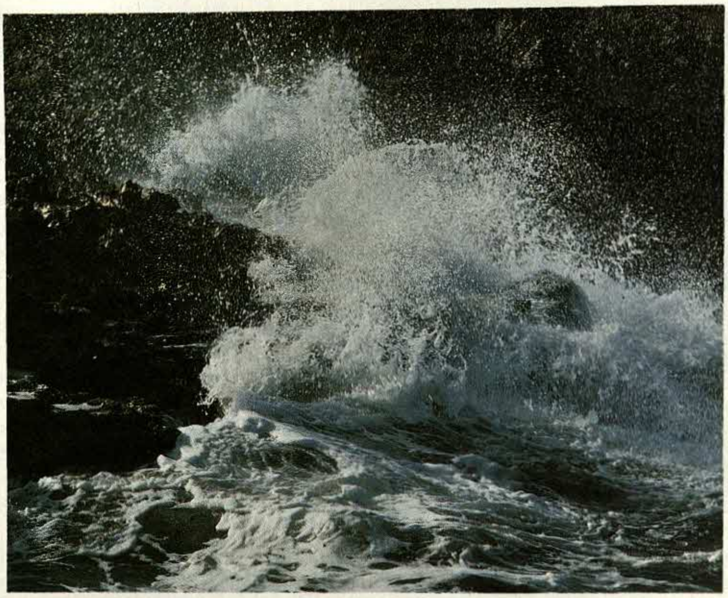
People with a chronic illness may worry that they will be unable to lead a normal life. An illness such as emphysema or heart disease can prevent people from participating in activities they enjoy. Occupational therapy helps such people redirect their energy into activities within their limits. For example, a patient recovering from a heart attack might substitute a less strenuous activity, such as walking, for tennis.

Children with learning disabilities can also be helped by occupational therapy. Some children may have difficulty recognizing shapes or colours. To help these children, a therapist provides games that requires the children to match objects of different size, shape, texture, and colour.

History

The idea behind occupational therapy goes back to A.D. 172, when the Greek physician Galen said: "Employment is nature's best medicine and essential to human happiness." During the late 1700's, doctors in several countries prescribed useful activities as treatment for mentally ill patients. These doctors included Philippe Pinel in France, Johann Christian Reil in Germany, and Benjamin Rush in the United States. As early as 1798, patients at the Pennsylvania Hospital for the Insane in Philadelphia were being taught such skills as carpentry, shoe repair, and needlework.

Modern occupational therapy developed from a nursing course called Invalid Occupations. This course was first offered to student nurses in 1906 by Susan E. Tracy, a Boston nurse. The term *occupational therapy* was first used by an American architect George E. Barton. He had received this form of treatment after the amputation of a foot. The need to help disabled veterans of World Wars I (1914-1918) and II (1939-1945) stimulated the growth of occupational therapy.



The vast ocean covers more than 70 per cent of the earth's surface, from the ice-choked seas of the polar regions, *lower left,* to the warm waters of the tropics, *above.* Its waters move constantly, whether crashing against a rocky coast, *upper left,* or gently rising and falling with the tide.

Ocean

Ocean is the great body of water that covers more than 70 per cent of the earth's surface. People also call it the *sea.* The ocean contains 97 per cent of all the water on the earth.

The ocean provides us with many things. It is far more than a place for swimming, sailing, and other recreation. The ocean serves as a source of food, energy, and minerals. Ships use the ocean to carry cargo between continents. But above all else, the sea helps keep the earth's climate healthy by regulating the air temperature and by supplying the moisture for rainfall. If there were no ocean, life could not exist on our planet. Instead, the earth would be a blisteringly hot, arid wasteland.

The bottom of the ocean has features as varied as those on land. Huge plains spread out across the ocean floor, and long mountain chains rise toward the surface. Volcanoes erupt from the ocean bottom, and deep valleys cut through the floor. Some of the mountains that rise above the ocean floor are about half as high as Everest, the highest peak on the earth's surface.

The ocean is a fascinating place that we have only begun to understand. Scientists called *oceanographers* work to discover the secrets of the sea. They study how the ocean moves and how it affects the atmosphere. They investigate how organisms live in the sea and how various forces shape the sea floor. Oceanographers work on board ships and submarines, often using sonar and other equipment. Such modern tools as satellites and computers have greatly increased scientists' understanding of the ocean.

The world ocean

The waters of the ocean form one great connected body often called the *world ocean* or the *global ocean.* However, the continents divide the world ocean into three major parts. They are, in order of size, the Pacific Ocean, the Atlantic Ocean, and the Indian Ocean. Each ocean includes smaller bodies of water called *seas, gulfs,* or *bays,* which lie along the ocean margins. For example, the Caribbean Sea and the Mediterranean Sea are part of the Atlantic, and the Bering Sea and the South China Sea are part of the Pacific. The word *sea* also means the ocean in general. See **Pacific Ocean; Atlantic Ocean; Indian Ocean.**

A small fourth ocean, known as the Arctic Ocean, lies north of Asia, Europe, and North America. Many geographers consider it part of the Atlantic rather than a separate ocean, and they refer to it as the Arctic Sea. See **Arctic Ocean**.

At the southern end of the earth, the Pacific, Atlantic, and Indian oceans meet around the continent of Antarctica. Some people call the waters surrounding Antarctica the Antarctic Ocean or the Southern Ocean. But many geographers prefer to take an alternative view. They say the waters are simply the southern parts of the three major oceans and do not form another ocean. See **Antarctic Ocean**.

The world ocean contains about 97 per cent of all the water on the earth. Most of the remaining water is frozen in glaciers and icecaps. The rest is in lakes and rivers, underground, and in the air.

Area. The world ocean covers about 70 per cent of the earth's surface. Most of the ocean lies in the Southern Hemisphere—that is, south of the equator. The Southern Hemisphere consists in area of about 80 per cent ocean, and the Northern Hemisphere about 60 per cent.

The Pacific Ocean is by far the largest of the world's oceans. It covers about 181 million square kilometres—nearly a third of the earth's surface. The Pacific contains about half the water in the world ocean and could hold all the continents. Near the equator, the Pacific stretches about 24,000 kilometres from Panama to the Malay Peninsula. North and South America border the Pacific on the east, and Asia and Australia lie to the west. To the north, the Bering Strait links the Pacific Ocean with Arctic waters.

The Atlantic Ocean covers about 94 million square kilometres, not including the waters of the Arctic. Europe and Africa lie east of the Atlantic, and North and South America lie west.

The Indian Ocean has an area of about 74 million square kilometres. Africa lies to the west. Australia and Indonesia lie to the east. Asia borders the Indian Ocean on the north.

Depth. The world ocean has an average depth of 3,730 metres, but parts of the ocean plunge much deeper. The deepest areas occur in *trenches*—long, narrow valleys on the sea floor. The deepest known spot is in the Mariana Trench in the western Pacific Ocean, near the island of Guam. It lies 11,033 metres below sea level. If the world's highest mountain, 8,848-metre Mount Everest in the Himalaya, were placed in that spot, more than 2 kilometres of water would cover the mountaintop.

The Pacific is the deepest ocean, with an average depth of 3,940 metres. The Atlantic is the shallowest ocean, averaging 3,580 metres deep. Its deepest known point, 8,648 metres below the surface, lies in the Puerto Rico Trench. The Indian Ocean averages 3,840 metres deep. Its deepest known spot plunges 7,125 metres below sea level in the Java Trench.

Temperature. The surface temperature of the ocean varies from about −2° C near the North and South poles to about 30° C near the equator. In the polar regions, the surface seawater freezes. The western tropical Pacific has the warmest surface water. Ocean currents affect the surface temperature. As the currents move about in the ocean, they carry warm tropical water toward the poles. Other ocean movements bring colder, deeper water up to the surface and so lower the surface water temperature.

Ocean temperature also varies with depth. In general, the temperature falls as the depth increases. The warm surface waters extend to depths of about 150 metres in the tropics, and about 300 metres in the subtropics. Below the surface waters, the temperature drops rapidly, forming a layer called the *thermocline*. The thermocline varies in thickness, from about 300 metres to 910

Interesting facts about the ocean

Life began in the ocean according to most scientists. Fossils of one type of sea worm, *right*, show that this organism has remained unchanged for over 500 million years.

There is a bit of "ocean" inside us. The body of an adult male contains about 18 litres of salt water. The composition of this fluid is similar to seawater.

The ocean floor is in constant motion. The floor of the Atlantic spreads about 2.5 centimetres every year, widening the ocean basin. The Pacific floor spreads even faster, about 13 centimetres every year. But its basin does not widen because the edges of its floor sink under the continents.

Giant kelp, a large brown seaweed, may grow up to 60 metres long, forming great underwater forests in the ocean.

A *tsunami*—a powerful wave caused by an earthquake—can reach a speed of 970 kilometres per hour and travel across an entire ocean.

The world ocean would rise about 60 metres if the Greenland and Antarctic icecaps were to suddenly melt. New York City would be submerged, with only the tops of the tallest buildings above water.

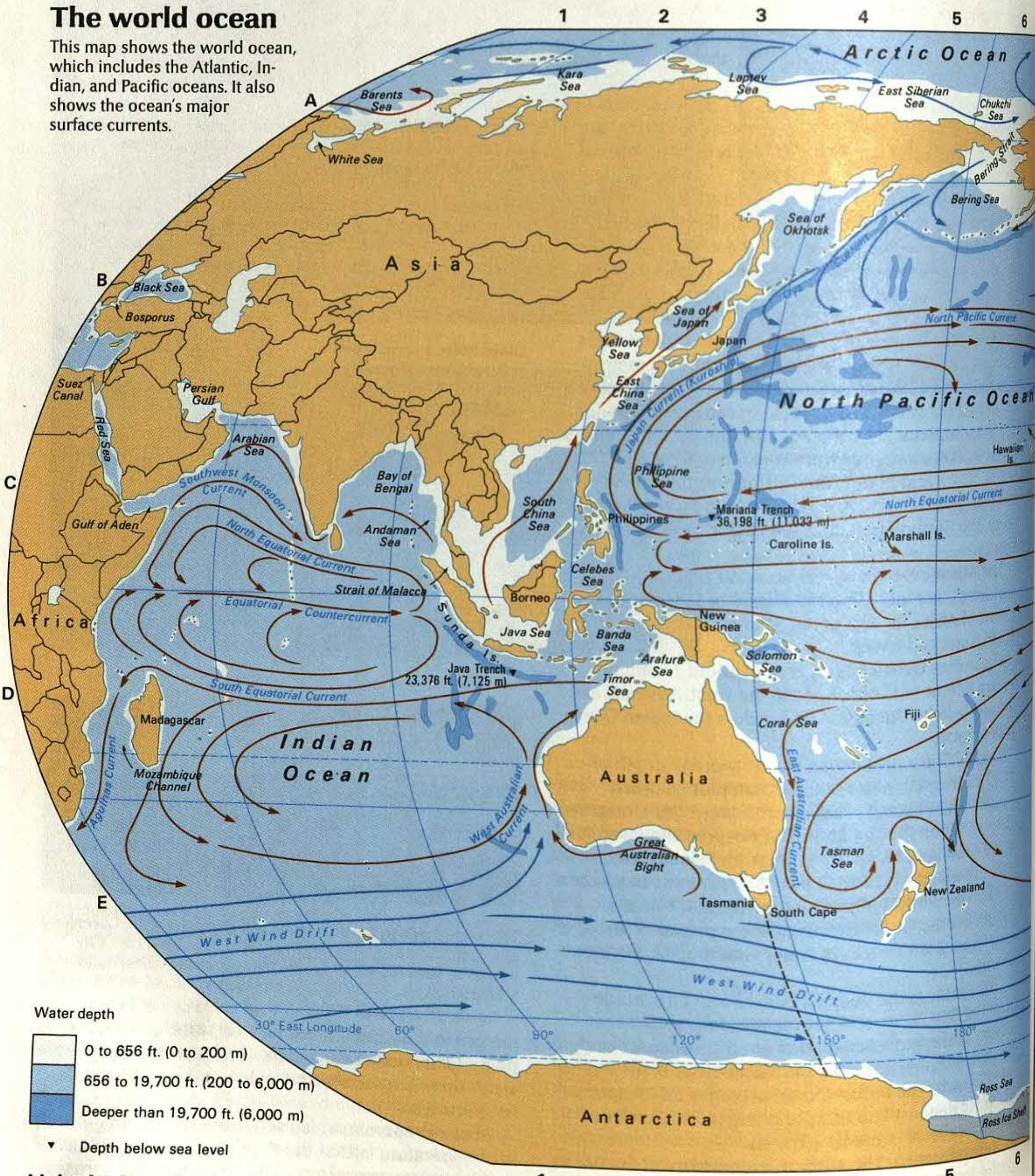
metres. Below the thermocline, the water cools more slowly. Close to the deep-sea floor, the temperature of the ocean ranges between 1° and 4° C.

Composition. Every natural element can be found in the waters of the ocean. But the ocean is especially known for its salts. Seawater contains, on the average, about $3\frac{1}{2}$ per cent salts. Six elements account for 99 per cent of the ocean's *salinity* (saltiness). They are, in order of amount, chlorine, sodium, sulphur (as sulphate), magnesium, calcium, and potassium. Most of the salty material in the sea consists of the compound sodium chloride, or ordinary table salt.

Many salts in the ocean come chiefly from the wearing away of rocks on land. As rocks break down, rivers carry the salts and other material the rocks consist of to the ocean. Material released by volcanoes and undersea

The world ocean

This map shows the world ocean, which includes the Atlantic, Indian, and Pacific oceans. It also shows the ocean's major surface currents.



Major bodies of water and major currents

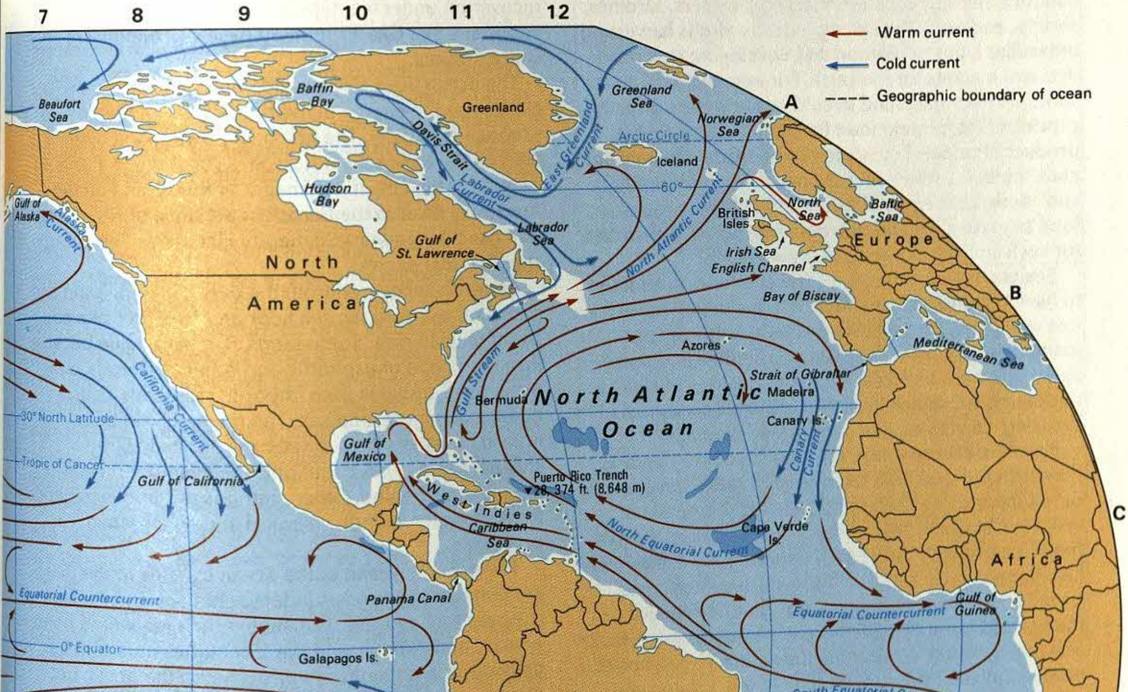
Arabian Sea	C	2
Arctic Ocean	A	5
Baffin Bay	A	9
Baltic Sea	B	12
Barents Sea	A	1
Bay of Bengal	C	2
Beaufort Sea	A	7
Bering Sea	B	6
Black Sea	B	1
Brazil Current	D	10
California Current	B	7
Caribbean Sea	C	9
Coral Sea	D	5
East China Sea	C	4
Greenland Sea	A	11
Gulf of Guinea	C	12
Gulf of Mexico	C	8
Gulf Stream	B	10
Indian Ocean	D	2
Irish Sea	B	11
Japan Current	B	4
Java Sea	D	3
Kara Sea	A	2
Labrador Current	A	10
Mediterranean Sea	B	12

springs also contributes salts to the ocean. Evaporation and precipitation further affect the ocean's salinity. Evaporation removes fresh water from the ocean surface, leaving behind the salts. Evaporation is high in subtropical areas, and so the surface waters are especially salty in those areas. Precipitation returns fresh water to the ocean. Precipitation is greater than evaporation near the equator, making surface waters less salty there. Rivers also bring fresh water to the ocean, which lowers the salinity of seawater near river mouths.

The importance of the ocean

As a wealth of resources. The ocean provides—or can provide—many major resources. They include (1) food, (2) energy, (3) minerals, and (4) medicines.

Food from the ocean consists mainly of fish and shell-



North Atlantic Current	B	11
North Atlantic Ocean	B	11
North Equatorial Current	C	5
North Pacific Current	B	6
North Pacific Ocean	C	4
North Sea	B	12
Peru Current	D	9
Philippine Sea	C	4
Red Sea	C	1
Sea of Japan	B	4
Sea of Okhotsk	B	4
South Atlantic Ocean	D	11
South China Sea	C	3
South Equatorial Current	D	7
South Pacific Ocean	E	7
Tasman Sea	E	5
Weddell Sea	F	10
West Wind Drift (current)	E	8
White Sea	A	1
Yellow Sea	B	4

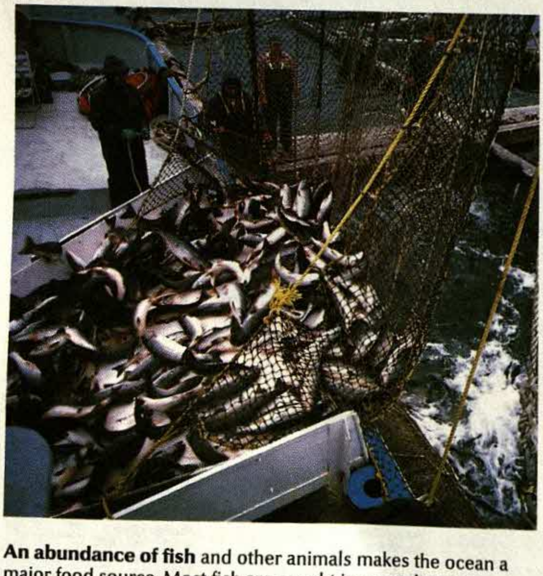
fish. The worldwide commercial fish and shellfish catch from the ocean totals about 90 billion kilograms annually. Most of the catch comes from coastal waters. People eat about 60 per cent of the fish and shellfish directly. Processors use the rest of the catch to make such products as fish oil and fish meal, which is added to livestock feed and pet food.

The world's fishing fleets harvest many kinds of fish and shellfish. The chief kinds include anchovies, cod, haddock, herring, lobsters, mackerel, oysters, sardines, shrimp, and tuna. The fishing industry also is harvesting unfamiliar types of seafood and developing new products and markets for the catch. For example, *krill,* a small shrimplike animal found in cold ocean waters, already provides high-protein food for people. *Surimi,* a fish product developed in Japan, can be made into imitation crab, lobster, scallop, and shrimp. Processors use hake and some other types of fish not traditionally eaten as food to make a protein powder. In addition, the market for such animals as squids is growing.

Seaweeds also serve as a source of food, in addition to having industrial uses. *Kelp,* a large, brown variety, is one of the most important seaweeds. Kelp contains many vitamins and such minerals as iodine and potassium. However, its chief value is as a source of *algin,* a thickening substance used in making ice cream, salad dressing, cosmetics, and many other products.

People are increasingly farming the ocean much as they farm the land. Fish farming, also called *aquaculture* or *mariculture,* has been practised for thousands of years in China and some other Asian countries. Its use has been growing in Western countries since the 1960's. Fish farmers raise fish, shellfish, and seaweeds near ocean shores as well as in ponds. They use special methods to make the animals and seaweeds grow faster and larger than they would in the wild. Fish hatcheries, a related industry, produce healthy young salmon and other young fish for release into the ocean. See **Aquaculture.**

Energy from the ocean has several forms. Petroleum and natural gas are the ocean's most valuable energy resources. Offshore wells tap deposits of oil and gas beneath the sea floor. In the late 1980's, offshore wells produced about 25 per cent of the world's oil and about 20 per cent of the world's gas. Scientists estimate that 3 trillion barrels of oil lie undiscovered beneath the ocean. Equally huge amounts of untapped gas accompany the oil. As gas and oil reserves on land are used up or become too difficult and expensive to obtain, finding and recovering undersea deposits will become increasingly important. See **Gas** (Producing gas); **Petroleum** (Offshore drilling).



An abundance of fish and other animals makes the ocean a major food source. Most fish are caught in coastal waters.

The ocean tides also provide energy. Tidal power facilities use the energy in the rise and fall of the tides to produce electricity. The first tidal power plant opened in 1966 on the Rance River near St.-Malo, France. Plants on a bay near the city of Murmansk in Russia and on the Annapolis River in the Canadian province of Nova Scotia also use tidal power to generate electricity. See **Energy supply** (Tidal energy).

Minerals recovered from the ocean include sand and gravel mined from the sea floor and used to make construction materials. Some sands also have value because they are rich in phosphorite and other chemicals. Seawater itself contains such important minerals as bromide, manganese, and salt. The minerals can be removed by letting the seawater evaporate in large shallow basins under sunlight. The evaporation leaves the minerals behind. Other methods to remove minerals from seawater include chemical and electrochemical processes.

The mineral wealth of the ocean extends to the deep-sea floor. Deposits near undersea hot springs contain copper, iron, and zinc. But mining the ores would be expensive and difficult, and the techniques must still be developed. Manganese deposits lie on the ocean bottom in lumps called *nodules.* The nodules also contain cobalt, copper, and nickel. Scientists are trying to develop ways to gather the nodules and bring them to the surface. Possible gathering techniques include using buckets that run on conveyor belts between a ship and the sea floor and operating a device that works like a giant vacuum cleaner.

Medicines have been produced from many forms of marine life. For example, plantlike organisms called *red algae* provide an *anticoagulant,* a drug that keeps blood from clotting. A species of marine snail produces a substance that relaxes muscles. Sea life has also been valuable in medical research. The blood of horseshoe crabs contains a substance used to test for various infections. The substance can also be used to determine the purity of many drugs. Researchers study giant nerve cells from lobsters, squids, and marine worms to learn more about nerve functions in people.

Other products from the ocean include coral, pearls, and shells used in jewellery. Sponges from the ocean bottom have higher quality than synthetic sponges. In many dry areas near seacoasts, people *desalinate* (remove the salt from) seawater to produce fresh water (see **Water** [Fresh water from the sea]).

As an influence on climate. The ocean helps keep the earth's environment healthy. The ocean's great size and the slowness of water to change temperature have a steadying influence on the temperature of the atmosphere. In summer, the ocean stores excess heat from the sun. In winter, when the sunlight is weaker, the ocean releases the stored heat into the air. Circulation of the ocean waters also affects air temperatures. Currents carry excess heat of tropical waters toward the poles, thereby cooling the tropics and warming the polar regions.

The ocean is the source of most of the precipitation that falls to the earth. The sun's heat evaporates water from the ocean surface. The water rises as invisible vapour and forms clouds as it cools. It then falls back to the earth as hail, rain, sleet or snow.

As a vast highway. The ocean has been a highway for trade since people built the first ships thousands of years ago. Today, transportation—especially of heavy and bulky products—remains an important use of the ocean. See **Ship; Transportation.**

Life in the ocean

An incredible variety of living things reside in the ocean. Marine life ranges in size from microscopic one-celled organisms to largest of all animals—the blue whale, which may measure up to 30 metres long. Ocean plants and plantlike organisms use sunlight and the minerals in the water to grow. Sea animals eat these organisms and one another. Marine plants and plantlike organisms can live only in the sunlit surface waters of the ocean, which is called the *photic zone.* The photic zone extends only about 100 metres below the surface. Beyond that point, the light is insufficient to support plants and plantlike organisms in the sea. Animals, however, live throughout the ocean, from the surface waters to the greatest depths.

All ocean life can be divided into three groups. These groups are (1) the plankton, (2) the nekton, and (3) the benthos.

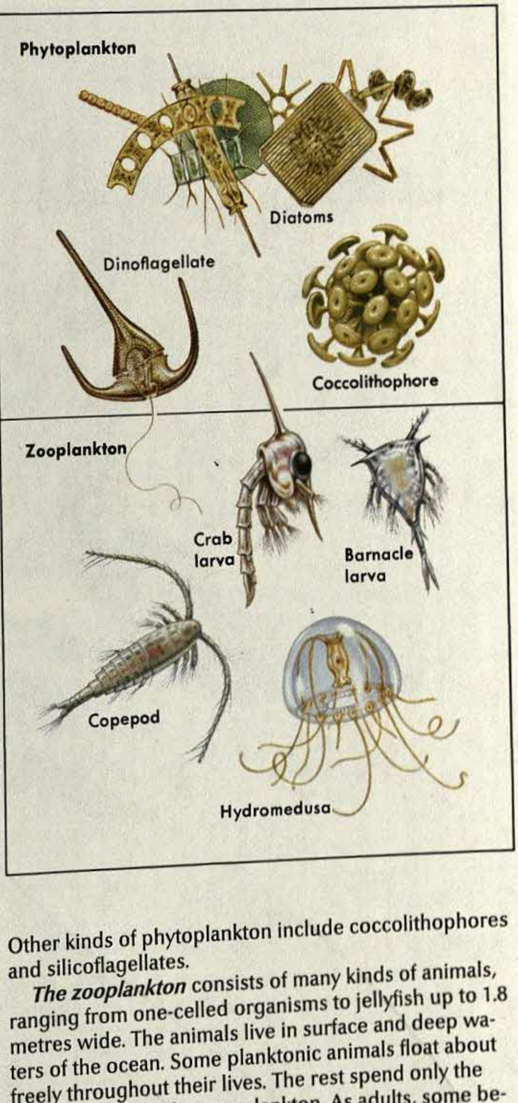
The plankton consists of plantlike organisms and animals that drift with the ocean currents. They have very little ability to move through the water on their own. Most of them cannot be seen without a microscope. The plantlike organisms of the plankton form the *phytoplankton,* and include such simple organisms as diatoms and other algae. The animals of the plankton form the *zooplankton.* Some minute types of bacteria are included in the plankton.

The phytoplankton consists of several kinds of plantlike organisms. Most have only one cell. The phytoplankton floats in the photic zone, where the organisms obtain sunlight and nutrients. Although the organisms generally drift about, some kinds have long, whiplike parts called *flagella* that enable them to swim. The phytoplankton serves as food for the zooplankton and for some larger marine animals.

The most numerous members of the phytoplankton are diatoms and dinoflagellates. A diatom consists of one cell enclosed in a hard, glasslike shell made of opal. Diatoms live mainly in the colder regions of the ocean. Some even live within sea ice. Most dinoflagellates also are one-celled organisms. They generally live in more tropical regions. A dinoflagellate has two flagella it can use to move in a swirling motion. Some species of dinoflagellates produce powerful poisons. When such species become plentiful, they may discolour the water and create a *red tide* that kills sea animals (see **Red tide**).

Plankton

Plankton consists of small marine organisms that drift with the ocean currents. The plantlike organisms are called *phytoplankton.* Planktonic animals are known as *zooplankton.*



Other kinds of phytoplankton include coccolithophores and silicoflagellates.

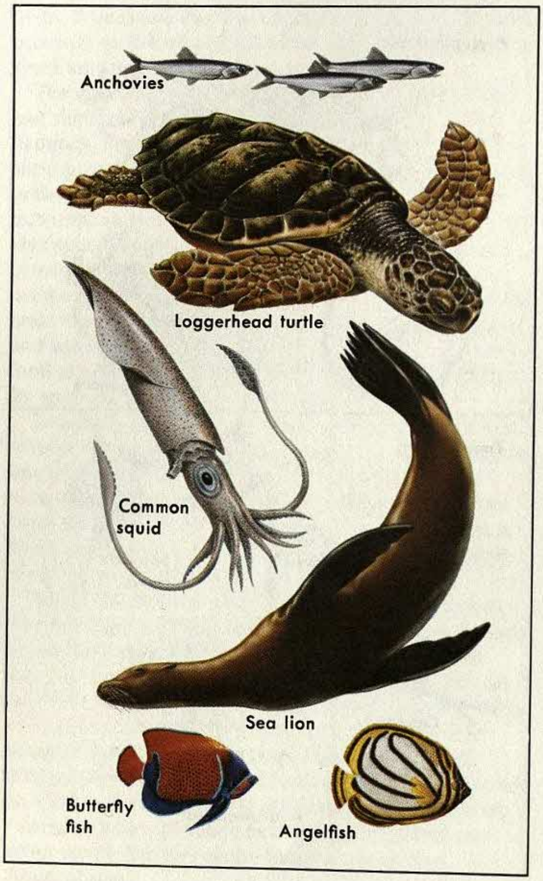
The zooplankton consists of many kinds of animals, ranging from one-celled organisms to jellyfish up to 1.8 metres wide. The animals live in surface and deep waters of the ocean. Some planktonic animals float about freely throughout their lives. The rest spend only the early part of their lives as plankton. As adults, some become strong swimmers and join the nekton. Others settle to the sea floor or attach themselves to it and become part of the benthos.

Crustaceans make up about 70 per cent of all planktonic animals. A crustacean has jointed legs, and a shell called an *exoskeleton* covers its body. Copepods are the most numerous crustaceans. Krill, which are also crustaceans, serve as food for fish, sea birds, seals, squids, and whales in the waters surrounding Antarctica. Other animals of the plankton include arrowworms and sea snails.

The nekton consists of animals that can swim freely in the sea. They are strong swimmers and include fish, squids, and marine mammals. Most species of nektonic animals live near the sea surface, where food is plenti-

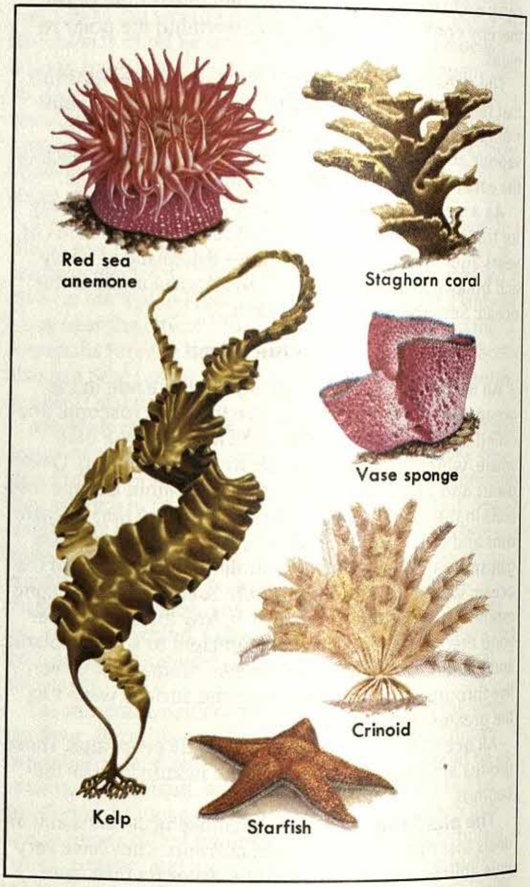
Nekton

Nekton is made up of fish and other animals that have the ability to swim freely in water without the help of currents. Most nektonic creatures live in the upper layer of the ocean.



Benthos

Benthos consists of marine organisms that live on the ocean bottom. Some members of the benthos are attached to the bottom in one position throughout their lives.



ful. But many other animals of the nekton live in the deep ocean.

Fish are the most important animals of the nekton. About 13,300 kinds of fish live in the ocean. They differ greatly in size and shape. The smallest fish, a goby with the scientific name *Trimmaton nanus,* lives in the Indian Ocean. It grows to about 1 centimetre long. The largest fish, the whale shark, measures up to 18 metres long. Such fish as the tuna and the mackerel have streamlined bodies that enable them to move rapidly through the water in search of food. Other fish, such as cod and flounder, have burrowing whiskers or flat bodies that help them feed along the ocean bottom. Many fish of the deeper parts of the ocean have light-producing organs. In this region, where daylight cannot penetrate, such light-producing organs may help attract prey. Such fish include deep-sea anglers and lanternfish.

Squids are free-swimming *molluscs* (animals with soft, boneless bodies) that have 10 arms. Related animals include octopuses and cuttlefish. Squids live in surface and deep waters. The animals may measure from less than 0.3 metre to as much as 18 metres long, including the arms. A squid moves backward through the water in a jetlike action by forcing water through a tube that lies beneath its head.

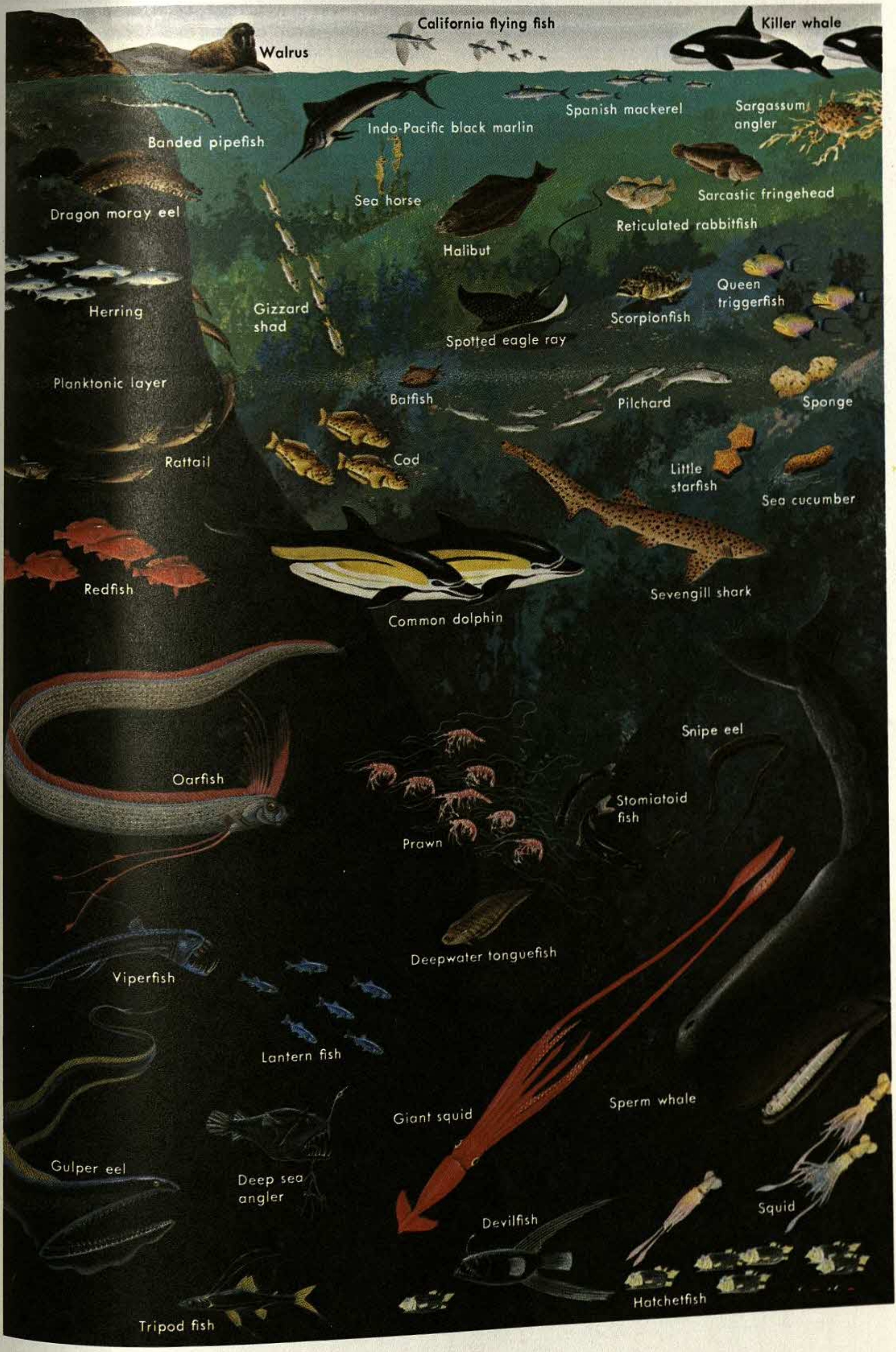
Nektonic mammals include dugongs, manatees, porpoises, and whales, all of which remain in the ocean all their lives. Other marine mammals, such as sea lions, sea otters, seals, and walruses, spend time on land.

The benthos is made up of marine organisms that live on or near the sea floor. Animals of the benthos may burrow in the ocean floor, attach themselves to the bottom, or crawl or swim about within the bottom waters. Where sunlight can reach the sea floor, the benthos includes plants and plantlike organisms, such as kelp and sea grass, which become anchored to the bottom. Among the common animals that live on the sea floor are clams, crabs, lobsters, starfish, and several types of worms. Some fish have features specially suited for life on the ocean floor. For example, halibut and sole, which lie flat on the bottom, have both eyes on the side of the head facing up.

Most bottom-dwelling creatures are part of the plankton and drift with the currents during the early stages of their development. They then sink to the sea floor where, as adults, they become part of the benthos. Such

Animals of the ocean

The creatures shown below represent only a small part of the great variety of animal life found in the ocean.



animals include barnacles, clams, corals, oysters, and various snails and worms.

The food cycle in the sea begins with the phytoplankton. In a process called *photosynthesis,* the organisms of the phytoplankton use sunlight, carbon dioxide, water, and nutrients in the water to produce food (see **Photosynthesis**). Certain animals of the zooplankton eat the phytoplankton. Those animals, in turn, become food for other members of the zooplankton or for fish and other animals of the nekton.

After ocean animals die, they begin to sink. Before most dead animals sink very far, they are eaten by creatures dwelling at lower depths. Animals begin to decay as soon as they die. In addition, animals give off waste products. The waste products—and dead animals that are not eaten—are broken down into mineral salts by bacteria. Rising currents carry the minerals to the surface, where the phytoplankton use them to make food, thus completing the food cycle.

In the late 1970's, oceanographers discovered vents in the deep-sea floor from which hot water flows. The scientists learned that the vents support thriving communities of marine life. However, the food cycle in the vent communities is not based on phytoplankton. Instead, certain forms of bacteria serve as the food base. In a process called *chemosynthesis,* the bacteria use chemicals in the hot water to grow and reproduce. Other organisms then feed on the bacteria. The section *Exploring the ocean* discusses hot vents more fully.

How the ocean moves

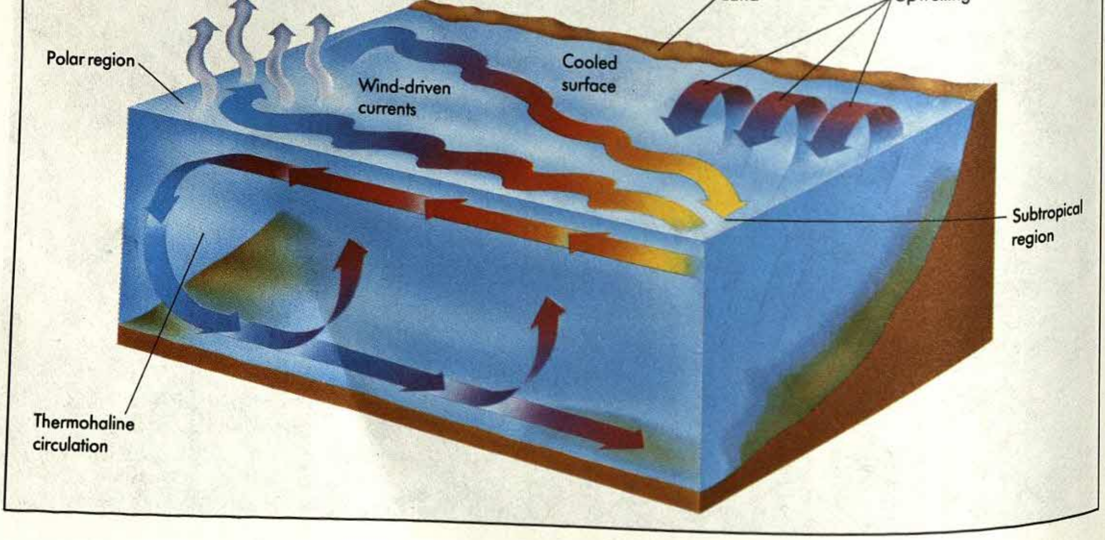
The waters of the ocean move constantly. Ocean currents course through the sea like giant rivers. Winds and earthquakes create waves across the surface of the ocean. Even the gravitational pull of the moon and sun causes movement, producing the daily rise and fall of the tides.

Currents. Two types of circulation create the currents in the ocean. They are (1) wind-driven circulation and (2) thermohaline circulation.

Wind-driven circulation results from the wind blowing on the ocean surface. The wind sets the surface waters into motion as currents. The currents generally flow horizontally—that is, parallel to the earth's surface. The wind mainly affects only the upper 100 to 200 metres of water. However, the flow of wind-driven currents may extend to depths of 1,000 metres or more.

Wind-driven currents move in enormous circular patterns called *gyres.* The gyres flow clockwise in the subtropics of the Northern Hemisphere and anticlockwise in the subtropics of the Southern Hemisphere. Several conditions influence the direction of wind-driven currents and make them form the gyres. The earth's wind systems drive the currents in an easterly or westerly direction (see **Wind**). On the other hand, the continents direct the flow toward the north or south. The earth's rotation further causes the currents' circular paths. Major wind-driven currents include the North and South Equatorial currents, the California Current, the Canary Current, the Gulf Stream, the Japan Current, the Labrador Current, and the Peru Current. The Antarctic Circumpolar Current, also called the West Wind Drift, is the strongest current in the ocean and the only one that circles the earth. See the map earlier in this article in the section *The world ocean* for the location of the major currents.

Ocean currents result from two forces: (1) the action of the wind on surface waters, and (2) the differences in temperature and salt content of surface and deeper waters. The earth's general wind circulation produces the major currents—great streams that carry the ocean's surface waters in roughly circular patterns. Wind also causes *upwelling,* which occurs when coastal waters are blown offshore and replaced by colder, deeper waters. *Thermohaline circulation* takes place because colder, saltier water sinks. This action produces great vertical currents in the ocean.



In some areas, *upwelling* occurs when winds cause surface waters near the coast to move offshore. Colder, deeper waters, which are rich in nutrients, then rise to the surface near the coast. The upwelling of deeper waters provides nutrients for the growth of tiny plantlike organisms, which fish and other sea animals eat. Upwelling areas have great numbers of fish and, in fact, yield half of the world's fish catch. Important upwelling regions include the coasts of Peru and northwestern Africa. Other areas where upwelling occurs lie along the equator and around Antarctica. Winds may also cause a *downwelling,* or sinking, of surface waters. Downwelling regions lack nutrients, and they support little marine life.

Thermohaline circulation produces great vertical currents that flow from the surface to the ocean bottom and back. The currents largely result from differences in water temperature and salinity. The currents move sluggishly from the polar regions, along the sea floor, and back to the surface. In the polar regions, the surface waters become colder and saltier. Being colder and saltier makes these waters heavier, and they sink toward the ocean bottom. The cold bottom waters then spread out slowly toward the equator. They gradually flow back toward the surface and replace the surface waters that sink.

Waves. In an ocean wave, water moves up and down. No forward motion of water occurs as the wave goes through the water. The action of an ocean wave resembles the waves you can make in a rope that is tied to a tree. When you shake the free end of the rope, waves run along it. But the rope itself does not move forward. When an ocean wave reaches land, however, it starts to drag on the bottom. Then the water also moves. See **Waves.**

The wind causes most ocean waves, from small ripples to giant hurricane waves more than 30 metres high. It makes the familiar lapping waves seen at the beach or from a ship. The size of such waves depends on wind speed, on how long the wind blows, and on how far it blows over the ocean. As the wind continues to blow out at sea, the waves grow to their greatest size and then break. The breaking waves are called *whitecaps.* After the wind stops, the waves continue to move over the ocean surface and can travel great distances from where they originated. They become smoother and longer. Finally, the waves reach the shoreline, where they break and form the surf.

The action of ocean waves changes the shoreline. Waves cut away sloping land and leave steep cliffs. They break up exposed rocks and form beaches. The movement of the waves and currents shapes beaches and builds up sand bars along the shore. Waves also carry beach sand away, particularly during storms when the waves are high and choppy.

Another type of wave results from sudden movements of the sea floor caused by earthquakes. The waves are often called *tidal waves,* though the tide does not cause them. Scientists call such waves *tsunamis.* On the surface of the open ocean, tsunamis can barely be seen. The waves measure only about 2.5 centimetres high. But they can travel as fast as 970 kilometres per hour. As they approach a coast, they slow down and may pile up to a tremendous height, causing great damage along the coast. Tsunamis have destroyed large towns and drowned hundreds of people. Most tsunamis strike land areas in or bordering the Pacific Ocean. Fortunately, scientists can predict how fast a tsunami is moving and are able to warn people in its path. See **Tidal wave.**

Tides are the rhythmic rise and fall of the ocean waters. Every day, the water slowly rises along the shoreline for about six hours. Then it slowly falls back for about six hours. Tides are caused chiefly by the gravitational pull of the moon on the earth. The pull is strongest on the side of the earth facing the moon. The moon's gravity pulls up the water directly below it, forming a high tide at that point. In addition, the earth's rotation, which tends to make water fly away from the earth's surface, causes water to pile up slightly on the side opposite the moon. At any one time, the moon's gravity therefore produces two bulges, or high tide areas, on the ocean.

The sun's gravitational pull also affects the ocean. But the distance between the sun and the earth is much greater than that between the moon and the earth. As a result, the sun causes tides only about half as high as those caused by the moon. The gravitational pull of the moon and sun combine during the full moon and new moon. At such times, the sun, moon, and earth are in a straight line. The tides then rise higher and fall lower than usual. They are called *spring tides.* When the moon is in its first and third quarters, the sun and moon are at right angles to each other. The resulting tides do not rise or fall as much as usual. They are called *neap tides.* See **Tide.**

The land at the bottom of the sea

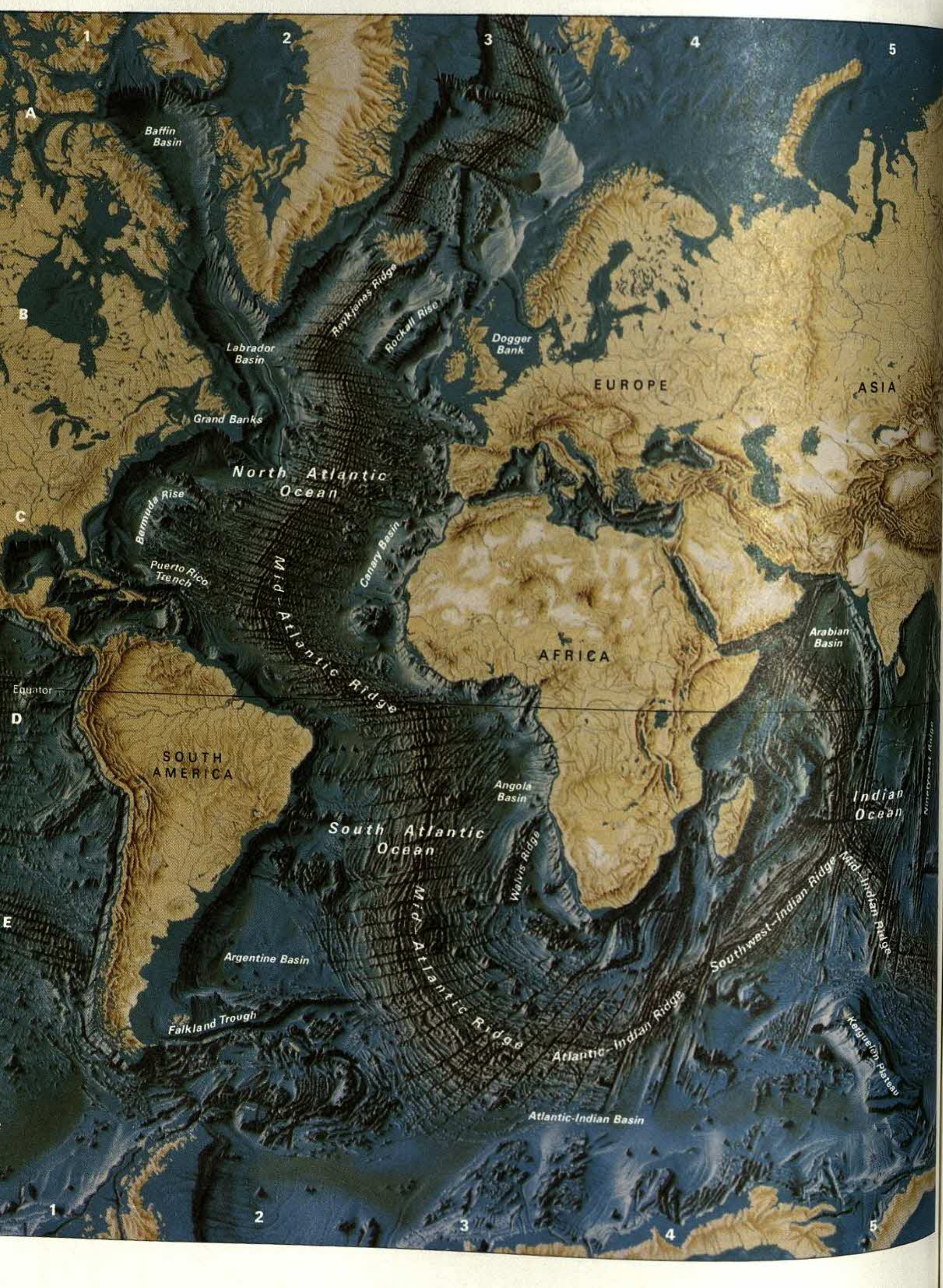
The ocean floor is a region of spectacular contrasts. Beneath the sea, broad plains cover huge distances, towering mountain chains circle the earth, undersea volcanoes rise toward the surface, and deep trenches and valleys cut through the bottom.

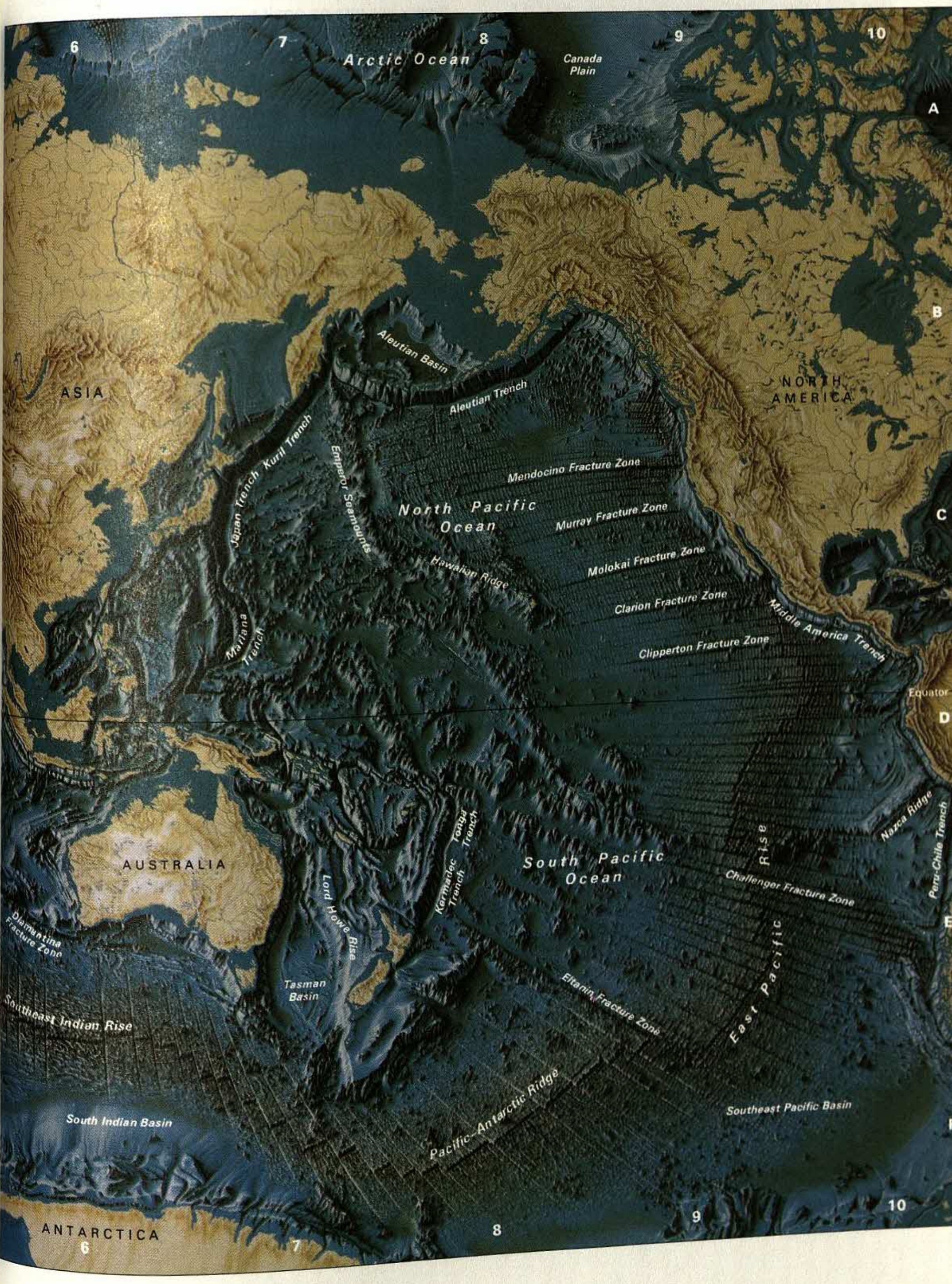
The continental margin forms the part of the seabed that borders the continents. It consists of (1) the continental shelf, (2) the continental slope, and (3) the continental rise.

The continental shelf is the submerged land at the edge of the continents. It begins at the shoreline and gently slopes underwater to an average depth of about 130 metres. The width of the continental shelf averages 75 kilometres. In certain areas, such as parts of the Arctic region, the shelf extends as far as 1,200 kilometres. In some other areas, particularly those bordering much of the Pacific, it measures only 1.6 kilometres or less. Valleys of varying depths cut through the shelf. The shelf collects much of the *sediment* (deposits of sand and mud) that is carried by rivers and deposited into the ocean.

The continental slope begins at the outer edge of the shelf. The slope is much steeper than the shelf and plunges to depths of 3.6 kilometres. The slope forms, in effect, the sides of the continents. Its width ranges from 20 to 100 kilometres. In many places, deep underwater canyons gash the slope. Some canyons rival the gigantic Grand Canyon of North America in size. Most such underwater canyons lie offshore from large rivers, and former rivers may have carved them. The movement of

The land beneath the oceans has varied features. It consists of huge mountain ranges; broad basins and plains; and long, narrow valleys. The map below shows the major landforms of the world's ocean floor. The map index on the page following this map indicates their locations.




6
7
8
9
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Arctic Ocean
Canada Plain
A
B
C
D
E
ASIA
NORTH AMERICA
Aleutian Basin
Aleutian Trench
Kuril Trench
Japan Trench
Emperor Seamounts
Mendocino Fracture Zone
North Pacific Ocean
Murray Fracture Zone
Hawaiian Ridge
Molokai Fracture Zone
Clarion Fracture Zone
Mariana Trench
Middle America Trench
Clipperton Fracture Zone
Equator
Nazca Ridge
Peru-Chile Trench
Tonga Trench
Kermadec Trench
AUSTRALIA
Lord Howe Rise
South Pacific Ocean
Rise
Challenger Fracture Zone
Diamantina Fracture Zone
Tasman Basin
Eltanin Fracture Zone
East Pacific
Southeast Indian Rise
Pacific-Antarctic Ridge
Southeast Pacific Basin
South Indian Basin
ANTARCTICA
6
7
8
9
10

sediment along the ocean bottom also may form some canyons.

The continental rise consists of sediment from the continental shelf and slope that accumulates at the bottom of the slope. The thick sediment deposits of the continental rise extend up to about 1,000 kilometres from the slope.

Deep-sea peaks, valleys, and plains lie beyond the continental margin in the ocean basin. The *midocean ridges* form a chief feature of the basin. The ridges consist of a chain of mountains that runs about 60,000 kilometres through the three major oceans. Scientists discovered the mountain chain independently in each ocean and gave it different names, including Mid-Atlantic Ridge, East Pacific Rise, and Mid-Indian Ridge. Most mountains of the midocean ridges stand about 1,500 metres above the sea floor. Some peaks rise above the surface and form islands, such as the Azores and Iceland in the Atlantic Ocean. Deep valleys cut across the ridges in many places, producing a rugged, fractured surface. Some midocean ridges have valleys that slice down through the centre of them. Frequent volcanic activity occurs along such central valleys.

The sides of the midocean ridges slope down into vast regions called *abyssal plains.* The accumulation of sediment buries most features of the ocean floor along the abyssal plains, which are flat as a result. The two chief sources of deep-sea sediment are the land itself and marine life. The breaking down and wearing away of rock produces land sediment, which rivers carry to the ocean. Wind also carries land sediment—mostly from deserts—to the ocean. In addition, volcanic eruptions spread large amounts of sediment over the ocean. Marine life sediment consists mainly of tiny shells and the remains of dead organisms of the plankton. When such matter makes up a large part of a sediment, scientists call it an *ooze* (see **Ooze**).

Other features of the deep-sea basin include the long, narrow trenches and isolated underwater mountains called *seamounts.* Trenches form the deepest parts of the ocean. Volcanic eruptions produce seamounts. The mountains have steep sides and may rise as high as 4,000 metres above the sea floor.

How the sea floor was formed. Since the late 1800's, scientists have developed several theories to explain how the sea floor was formed. The theory of continental drift first received wide attention during the early 1900's. According to the continental drift theory, the continents originally consisted of a single great land mass surrounded by one ocean. The mass broke up into continents, which slowly drifted apart. The theory explains why the shape of the eastern coast of the Americas and that of the western coast of Africa seem to fit together like pieces of a jigsaw puzzle. New oceans, including the Atlantic and the Indian oceans, resulted from the drift of the continents.

At first, many scientists rejected the continental drift theory because no one could explain what forces might move continents. Then in the early 1960's, a theory called *sea-floor spreading* provided some explanation. According to the theory, the sea floor itself moves, carrying the continents along. Circulating movements deep within the earth's *mantle*—that is, the thick layer of hot melted rock beneath the earth's crust—make the sea floor move. The circulating movements carry melted rock up to the midocean ridges and force it into the central valleys of the ridges. As the melted rock cools and hardens, it forms new sea floor and pushes the old floor and the continents away from the ridges.

Another theory, called *plate tectonics,* combines and expands on the ideas of sea-floor spreading and continental drift. According to plate tectonics, the earth's outer shell consists of huge rigid plates that move continuously. As the plates move, they carry the ocean floor and the continents with them. The plates move about 1.3 to 20 centimetres a year. Different movements of the plates have different effects on the ocean bottom and the continents. Sea-floor spreading—and the formation of new sea floor—occurs where plates move apart. The midocean ridges mark such areas.

As plates move away from one another in one place, they must move toward one another elsewhere. When two plates collide, one plate may pile up against the other, forming mountains. Or one plate may be drawn down into the mantle under the other plate. Such action produces trenches and volcanoes. Earthquakes occur at the boundaries of plates that slide past one another. The Atlantic Ocean is slowly growing wider and the Pacific smaller because of plate tectonics. See **Earth** (illustration: The earth's plates); **Plate tectonics**.

The oceanic crust forms the ocean floor. It consists of hard rock called *basalt.* The continents lie on the continental crust, which consists mainly of granite. Granite is lighter than basalt, and so the continental crust basically "floats" on the mantle, above the oceanic crust. The ocean basins, as sunken areas, thus collect water. Scientists have several theories to explain how the ocean basins originally filled with water. But most scientists believe that the water came from the earth's interior and was released as water vapour through volcanoes. As the earth cooled, the vapour condensed to water and fell as rain, filling the ocean basins.

Exploring the ocean

Why explore the ocean? As we have seen, the ocean serves as a source of food, energy, minerals, and

Features of the ocean floor

This index lists the main features shown on the map on the preceding two pages.

Aleutian Basin	B	8
Aleutian Trench	B	8
Angola Basin	D	3
Arabian Basin	D	5
Argentine Basin	E	2
Atlantic-Indian Basin	F	4
Atlantic-Indian Ridge	F	4
Baffin Basin	A	1
Bermuda Rise	C	1
Canada Plain	A	8
Canary Basin	C	2
Challenger Fracture Zone	E	9
Clarion Fracture Zone	C	9
Clipperton Fracture Zone	D	9
Diamantina Fracture Zone	E	6
Dogger Bank	B	3
East Pacific Rise	E	9
Eltanin Fracture Zone	E	9
Emperor Seamounts	C	7
Falkland Trough	E	2
Grand Banks	B	2
Hawaiian Ridge	C	8
Japan Trench	C	7
Kerguelen Plateau	F	5
Kermadec Trench	E	8
Kuril Trench	C	7
Labrador Basin	B	2
Lord Howe Rise	E	7
Mariana Trench	C	7
Mendocino Fracture Zone	C	8
Mid-Atlantic Ridge	D 2, E	3
Mid-Indian Ridge	E	5
Middle America Trench	D	10
Molokai Fracture Zone	C	9
Murray Fracture Zone	C	9
Nazca Ridge	D	10
Ninetyeast Ridge	D	5
Pacific-Antarctic Ridge	F	8
Peru-Chile Trench	E	10
Puerto Rico Trench	C	1
Reykjanes Ridge	B	2
Rockall Rise	B	3
South Indian Basin	F	6
Southeast Indian Rise	E	6
Southeast Pacific Basin	F	9
Southwest Indian Ridge	E	5
Tasman Basin	E	7
Tonga Trench	D	8
Walvis Ridge	E	3

medicines. It is important for transportation and trade. It provides recreation in the form of boating, fishing, swimming, and other activities. The action of the ocean and the atmosphere on each other affects the weather and the climate. We depend on the ocean in so many ways that we should find out all we can about it. By exploring and understanding the ocean, we can learn to manage its resources wisely.

Tools of exploration. To understand the ocean better, scientists must gather information about its behaviour. The tools that oceanographers use in their efforts to explore the sea include (1) research ships, (2) research submarines called *submersibles,* (3) satellites, and (4) computers.

Research ships typically measure about 30 to 90 metres long and include laboratory space where scientists can work while at sea. Oceanographers travel on research vessels to make observations and take measurements. They may stay at sea for weeks or months at a time. They often work in rough seas and in distant locations.

Oceanographers use several types of instruments on research ships. They operate underwater cameras to photograph the sea floor. Electronic devices send out sound waves and record the echoes from the ocean floor. The records of the echoes provide information about the depth of the sea. The most powerful of such instruments records echoes from deep within the earth's crust. Scientists analyse the records to learn about the structure of the crust. Oceanographers also use special devices to collect samples of seawater from various depths and then measure the temperature, salinity, and other characteristics of the seawater samples. Nets towed behind research ships gather samples of marine life for study.

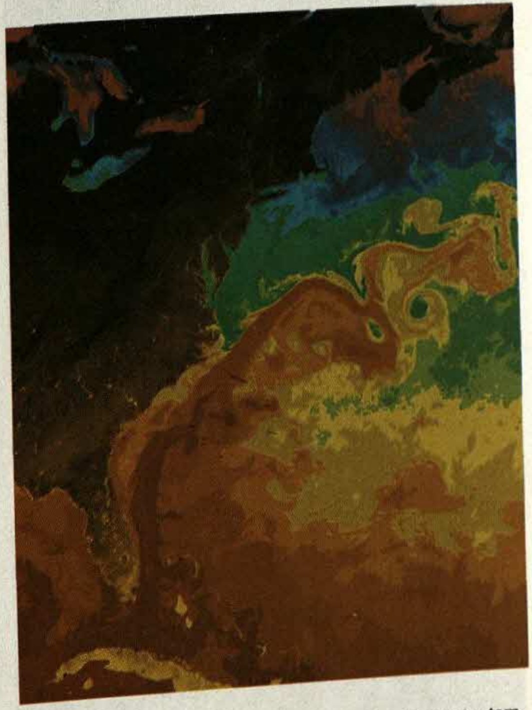
Oceanographers also use a number of floating devices. For example, a *mooring* consists of an anchor and a float connected by a cable. The float may be placed on the ocean surface or at a determined depth. Scientists attach various instruments to the cable section of a mooring. Some instruments measure the speed and direction of ocean currents at different depths. Other devices record the temperature and salinity of the water. A mooring may remain out at sea several years before the research ship picks up the device and its data.

Other floating devices include *buoys,* which drift with the ocean's surface currents. Buoys chiefly provide information about ocean circulation. However, they may also record air pressure or surface water temperature. Buoys relay data to scientists through orbiting space satellites. Certain buoys can drift with currents below the ocean surface.

Oceanographers use specialized ships that have equipment to drill deep into the ocean bottom. The equipment removes *cores* (samples) of sediment and hard rock from beneath the sea floor. The cores are able to provide scientists with valuable information about the age, composition, and development of the ocean floor.

Submersibles can descend to the depths of the ocean. They enable scientists to observe features on the sea floor that may be missed by instruments lowered from research ships on the surface. *Manned submersibles,* such as the U.S. *Alvin* and *Turtle,* carry a human crew. The crew members take photographs and, using a mechanical arm outside the vessel, gather samples and set out instruments. *Unmanned submersibles* carry no crew. They have television cameras that scientists operate from a surface ship. In 1985, two unmanned submersibles—the U.S. *Argo* and the French *Sar*—found and explored the wreckage of the *Titanic,* a British pas-

The submersible *Alvin* can carry a crew of scientists to the ocean floor, where they take photographs and gather samples.



Satellite photographs can provide data on surface water temperatures and current patterns in the ocean. In the satellite picture above, red and orange indicate the warmest temperatures, and blue and purple represent the coldest. The Gulf Stream is visible as a red "river" off the coast of North America, *left.*

senger ship that sank in the Atlantic in 1912. Submersibles can also carry divers to the ocean depths, where they leave the vehicles to study the ocean environment directly. See **Diving, Underwater.**

Satellites transmit data from buoys and other instruments at sea to oceanographers on shore. They also provide views of vast expanses of the sea from their position high above the earth. Satellite photographs can show the distribution of sea ice, the extent of surface oil slicks, and the cloud formations over the ocean. Satellites can also be used to map the temperature and colour of the ocean surface, enabling scientists to study daily variations in the routes and patterns of ocean currents. Oceanographers rely increasingly on satellites, which supply a greater range of information more quickly than do research ships.

Computers enable oceanographers to collect and analyse the enormous amounts of data obtained every day from satellites and from instruments on research ships. Scientists also use computers to create *models* (mathematical representations) of the ocean's movement and structure. They study the models to understand and predict the ocean's behaviour and its effect on the environment.

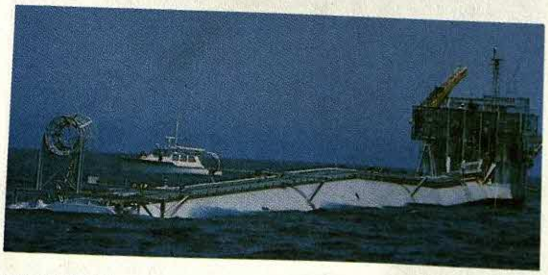
Discoveries. Oceanographers constantly discover new and interesting facts about the sea. One of the most exciting discoveries occurred in 1977, when scientists detected a hot vent on the sea floor near the Galapagos Islands in the eastern Pacific Ocean. Discoveries of similar vents followed, chiefly in the eastern Pacific. Hot vents occur along the midocean ridges, where the sea floor is expanding, at depths of about 2,500 to 3,000 metres. Water containing such minerals as copper, iron, and zinc flows from the vents. As the hot water comes into contact with the colder seawater, the minerals settle out and form deposits around the vents. The deposits take the shape of "chimneys" through which the water shoots out. The presence of iron darkens the water, and so black "smoke" appears to be flowing from the chimneys. For that reason, hot vents are often called *black smokers.*

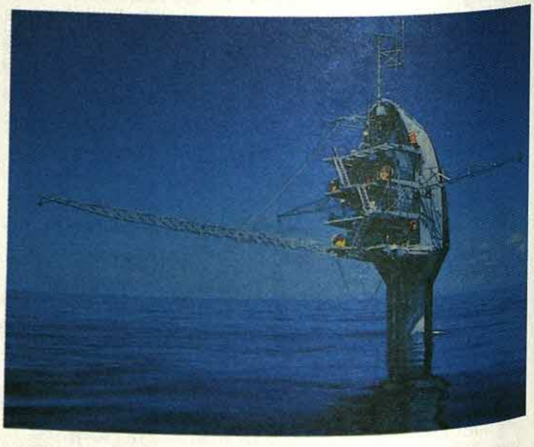
A wave-and-current channel reproduces the actions of ocean waves for study in a laboratory. By observing the channel, scientists gain detailed information about ocean water movements.

The hot vents support large communities of strange marine life. Certain forms of bacteria use chemicals in the hot water to grow and reproduce. The bacteria serve as the base of the food chain of the vent communities. Other forms of life found near hot vents include clams up to 30 centimetres long and giant, bright red tubeworms measuring up to 3.7 metres long. Scientists have further discovered various species of crabs, fish, shrimp, and other animals in the vent communities. Most of the animals were previously unknown species of marine life.

Oceanographers also make discoveries as they apply new tools and techniques to familiar subjects of research. For example, the use of satellites and computers has increased their understanding of El Niño, a marine *phenomenon* (event) that occurs about every two to seven years. During an El Niño, a warm current flows southward along the west coast of South America, warming the normally cold coastal waters of Ecuador and Peru. The term El Niño also refers to the current itself. The warming of the ocean waters kills many fish and sea birds, damaging the economy of Ecuador and Peru.

For many years, El Niño was considered only a local phenomenon. In the late 1960's, however, scientists observed a connection between El Niño and a change in the wind pattern over the entire tropical Pacific Ocean. Scientists used the information to predict an El Niño for





The *FLIP* (*FL*oating *I*nstrument *P*latform), *above,* glides through the water like any other ship. But when tanks in its long hull are filled with water, the stern of the vessel sinks. Its bow rises vertically and becomes a stationary oceanographic research laboratory, *right.*

the first time in 1975. In 1982 and 1983, the shift in wind pattern over the tropical Pacific led to a particularly powerful El Niño that affected rainfall in several parts of the world. For example, droughts occurred in Australia and Indonesia, while floods drenched parts of South America. Oceanographers continue to study El Niño closely. Improvements in their ability to predict the phenomenon would benefit countries in many parts of the world. See **El Niño**.

Ocean problems

Ocean pollution. *Pollutants* (substances that cause pollution) enter the ocean through accidents, carelessness, and the deliberate dumping of wastes. The ocean can absorb some types of pollutants in certain quantities because of its great size and the natural chemical processes that occur within it. But people continue to introduce more and more pollutants into the sea. The ocean will not be able to absorb it all. The ocean provides us with many necessities—and it helps keep our environment healthy. It is therefore extremely important that we work to control ocean pollution.

Oil is a major source of ocean pollution. Most oil pollution enters the ocean from oil spills on land or in rivers used to transport petroleum. Oil also seeps into the ocean naturally from cracks in the sea floor. Oil tanker and oil well accidents at sea account for only a small portion of ocean oil pollution, but their effects may be disastrous. The world's largest accidental oil spill occurred in June 1979, when an oil well blew out off the east coast of Mexico and spilled about 490 million litres of oil. The world's worst tanker oil spill occurred in March 1978, when a tanker ran aground off the coast of France, spilling 257 million litres. A major oil spill in the United States occurred in March 1989, when a tanker ran aground off Alaska and leaked nearly 42 million litres. What may have been the world's largest oil spill occurred when Iraq deliberately released about 950 million litres of oil into the Persian Gulf during the Persian Gulf War (1991). In water, much of the oil forms tarlike lumps, which litter beaches and other coastal areas. Oil also coats fish, birds, and marine mammals, killing many of them.

An oil spill—in this case the result of an oil tanker accident—is a well-known example of ocean pollution. Such spills foul the water and coastlines, killing both sea and land organisms.

A marine biologist, *above,* studies life in the ocean. A net is used to gather tiny animals and plantlike organisms.

Scientists and engineers have devised several methods to clean up oil spills. One method involves placing a ring of floating devices around the spill to prevent it from spreading. Pumps or skimming devices then collect the oil, which floats on the surface of the water. Oil may also be recovered by placing sheets or particles of floating, oil-absorbing material on the ocean surface. Burning the oil cleans a spill, but it produces air pollution. Detergents help break up spills, but they may cause additional harm to marine life.

Ocean dumping. The deliberate dumping of waste products into the sea is another major source of ocean pollution. Such products include industrial wastes and sewage. Industries dump chemicals, animal and plant matter, and other pollutants. Sewerage systems carry human wastes, ground-up refuse, and water used for bathing and laundering to the sea. Waste treatment plants remove some of the most poisonous wastes from sewage, but most treated sewage still contains material harmful to the ocean. By the late 1980's, the industrialized nations were dumping billions of metric tons of waste products into the ocean every year. But in 1988, the United States passed a law banning all U.S. ocean dumping by 1992.

Plastics dumped into the ocean form an especially damaging group of pollutants because they do not break down easily. Sea birds, turtles, seals, whales, and other marine animals eat plastic nets, bags, and packing material. Animals that mistake plastic items for food die of starvation if the plastic blocks the digestive system. Tiny plastic pellets also litter the ocean. These pellets tend to float on the ocean surface, where they disrupt the environment of microscopic, surface-dwelling organisms.

By the late 1980's, an estimated 6.4 billion kilograms of plastic was being dumped into the ocean annually. The figure includes plastic waste discarded from ships and fishing vessels. In December 1988, an international treaty banning the dumping of plastics from ships and other vessels went into effect. The United Kingdom, the United States, and several other countries have ratified the treaty.

Who owns the ocean? This question has become increasingly important as countries have learned that fish and other ocean resources can be used up and that valuable minerals lie on and under the sea floor. Various United Nations committees have worked to develop an agreement on ownership of the sea. Their efforts resulted in the Law of the Sea Treaty, drafted by a conference in 1982. The treaty went into effect in 1994, after more than 60 nations ratified it. The treaty calls for a system to protect the economic and environmental interests of coastal nations, while allowing the free passage of other countries' ships.

Under the treaty, the laws of a coastal nation apply throughout its *territorial sea,* which extends 12 nautical miles (22 kilometres) from the nation's shoreline. An *exclusive economic zone* (EEZ) extends, in most cases, 200 nautical miles (370 kilometres) beyond the nation's territorial sea. This means that each coastal nation, even if it is an island, has total control over resources and research within its EEZ. The remaining ocean area is defined as the *high seas,* where no nation may make a territorial claim. But even on the high seas, various international agreements govern fishing methods and fishing catches.

The Law of the Sea also makes provisions concerning the resources of the sea floor. In particular, the treaty refers to the minerals, such as manganese, cobalt, copper, and nickel, that lie on or under the sea bed. It states that mining operations should be supervised by an international sea-bed authority.

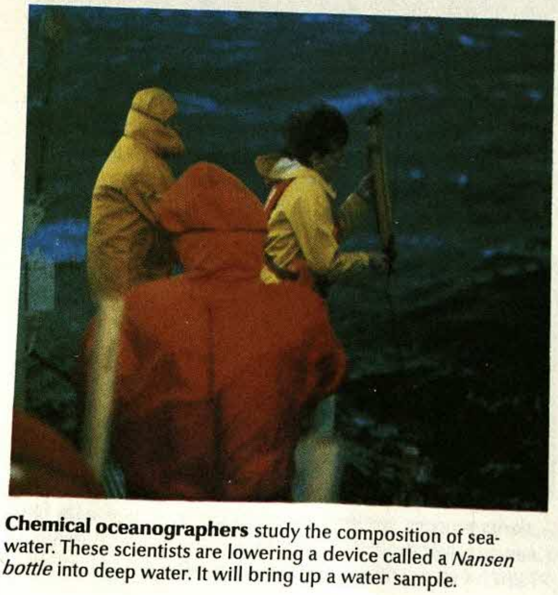
Oceanography

The ocean can be studied in many ways, and the science of oceanography includes many specialities. *Physical oceanographers* study waves, tides, currents, and the action of the ocean and the atmosphere on each other. *Chemical oceanographers* deal with the chemicals in seawater and the chemical reactions that occur in the ocean. *Marine geologists* and *marine geophysicists* analyse the form and composition of the sea floor, as well as the forces that shape the ocean floor. Marine geologists mainly study the sediments and surface features of the ocean bottom. Marine geophysicists deal with the deeper oceanic crust. *Biological oceanographers* and *marine biologists* study marine life, from microscopic bacteria to large marine mammals. *Ocean engineers* design oceanographic research tools and develop methods for obtaining minerals and other resources from the sea. Oceanographers may also work with computers in an attempt to try to re-create, analyse, and predict ocean behaviour.

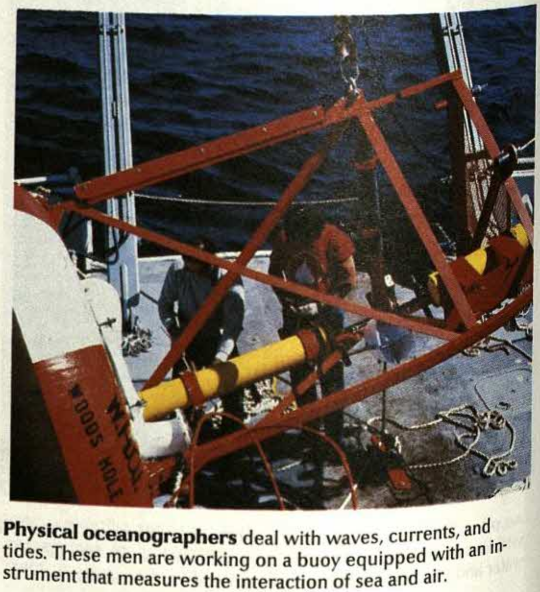
Related articles in *World Book* include:

Oceans

Antarctic Ocean
Arctic Ocean
Atlantic Ocean
Indian Ocean
Pacific Ocean



Chemical oceanographers study the composition of seawater. These scientists are lowering a device called a *Nansen bottle* into deep water. It will bring up a water sample.



Physical oceanographers deal with waves, currents, and tides. These men are working on a buoy equipped with an instrument that measures the interaction of sea and air.

Marine geologists study sediments and surface features of the ocean bottom. These scientists are examining *cores* (samples) of sediment and hard rock drilled from beneath the sea floor.

Seas

Adriatic Sea
Aegean Sea
Arabian Sea
Azov, Sea of
Baltic Sea
Barents Sea
Bering Sea
Black Sea
Caribbean Sea
China Sea
Coral Sea
Ionian Sea
Irish Sea
Japan, Sea of
Kara Sea
Marmara, Sea of
Mediterranean Sea
North Sea
Okhotsk, Sea of
Red Sea
Sulu Sea
Tasman Sea
Tyrrhenian Sea
White Sea
Yellow Sea

Currents

Gulf Stream
Japan Current
Labrador Current
Peru Current

Life in the ocean

Animal (pictures: Animals of the oceans)
Coral
Crustacean
Diatom
Dinoflagellate
Fish
Plankton
Seaweed
Sponge
Whale

Other related articles

Bathyscaph
Bore
Cable
Calms, Regions of
Climate
Deep
Diving, Underwater
El Niño
Fathometer
Fishing industry
Geology
Grand Banks
Life (Modern theories)
Maelstrom
Magnesium
Marine biology
Navigation
Ooze
Pearl
Plate tectonics
Red tide
Sargasso Sea
Sea level
Seashore
Seiche
Seven seas
Ship
Skin diving
Sonar
Tidal wave
Tide
Transportation
United Nations (Peaceful uses of the seabed)
Water (Fresh water from the sea)
Waves

Outline

- **I. The world ocean**
  - A. Area
  - B. Depth
  - C. Temperature
  - D. Composition
- **II. The importance of the ocean**
  - A. As a wealth of resources
  - B. As an influence on climate
  - C. As a vast highway
- **III. Life in the ocean**
  - A. The plankton
  - B. The nekton
  - C. The benthos
  - D. The food cycle
- **IV. How the ocean moves**
  - A. Currents
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- **V. The land at the bottom of the sea**
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- **VI. Exploring the ocean**
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- **VII. Ocean problems**
  - A. Ocean pollution
  - B. Who owns the ocean?
- **VIII. Oceanography**

Questions

What are *black smokers*?
Where do organisms of the benthos live?
What major resources does the ocean provide?
What is the theory of *sea-floor spreading*?
How much of the earth's surface does the ocean cover?
What types of information do oceanographers receive from satellites?
What are *tsunamis*?
How does the moon affect the movement of the ocean?
Where is the deepest known spot in the ocean?
What is *upwelling*?
Why should we work to control ocean pollution?

Ocean liner. See **Ship** (Ocean liners).

Oceanarium. See **Aquarium.**

Oceania. See **Pacific Islands.**

Oceanography. See **Ocean** (Oceanography).

Oceanus, in Greek mythology, was the river that was believed to encircle the world. Oceanus was also the name of the ancient god who was associated with this river. The god Oceanus was a *Titan,* one of the family of beings born to Uranus (the sky god) and Ge, or Gaea (the earth goddess) soon after the creation of the world. Oceanus was the husband of Tethys, who was also a Titan and a goddess of the sea.

The Greeks considered the waters of Oceanus the source of all other rivers and river gods. The kindly old Oceanus and Tethys were the parents of the Oceanids, 3,000 sea nymphs, and another 3,000 stream spirits. The waters of Oceanus marked the limits of all known lands and the boundary between the real world and the realm of imagination, fables, and dreams. According to one myth, the sun, after setting in the west, travelled back to the east over the waters of Oceanus in a golden bowl. When the stars set, poets used to say they bathed in Oceanus.

Ocelot is a medium-sized animal of the cat family. It is known as the *leopard cat* or *tiger cat* of America. It is 105 to 120 centimetres long including the tail, which is about 40 centimetres long. The ocelot stands 40-45 centimetres high at the shoulder. The ocelot lives

The ocelot lives in brushy and wooded areas from southwestern North America to central South America. Ocelots are agile climbers and often hunt small animals.

in an area ranging from southeastern Arizona and southern Texas in the U.S.A., to Paraguay in South America. It spends most of its life on the ground, but often hunts in forest trees and is an agile climber. It eats mice, wood rats, rabbits, snakes, lizards, birds, young deer, and monkeys. In the tropics a favourite food is agouti. If taken young, the ocelot can be tamed and makes an excellent pet.

The ground tint of ocelot fur varies greatly in different animals, from reddish-yellow to smoky-pearl. Black spots vary in size from dots on the legs and feet to large shell-shaped spots on other parts of the body. The ocelot has a pink nose and large, translucent eyes.

Ocelots have been widely hunted for their fur, and their number has decreased sharply. Laws that prohibit the hunting of ocelots have been hard to enforce.

Scientific classification. The ocelot belongs to the cat family, Felidae. It is *Felis pardalis.*

See also **Animal** (picture: Animals of the tropical forests).

Ocho Rios is a resort of natural beauty in Jamaica. It lies approximately 100 kilometres east of Montego Bay. It is a sheltered bay surrounded by coconut groves and sugar cane and fruit plantations. Ocho Rios is a tourist attraction boasting beaches, markets, shops, restaurants, hotels, and other recreational facilities. Areas of interest nearby include Fern Gully, an area of unspoilt tropical vegetation, Roaring River Falls, which has been partly used for hydroelectric power, and Dunn's River Falls.

Ochre is a kind of earth which is ground to a fine powder and used as a pigment with linseed oil or some other oil to form artist's paint. Its colour varies from pale yellow to brownish-red. Some yellow ochres turn red when heated. Ochre consists of iron oxide mixed with clay and sand.

Ockham's Razor. See **William of Ockham.**

O'Connell, Daniel (1775-1847), an Irish statesman, helped lead the struggle of Roman Catholics to gain political rights in Britain. This struggle resulted in the passing of the Catholic Emancipation Act of 1829. That act gave Catholic men the right to serve in the British Parliament and to hold most other public offices. Previously, Catholics were denied these rights in primarily Protestant Britain. The new law had a major effect in Ireland, a part of Britain where most of the people were Catholics. O'Connell, called "the Liberator," became the first Irish Catholic to win election to the British House of Commons. He served there from 1829 to 1847.

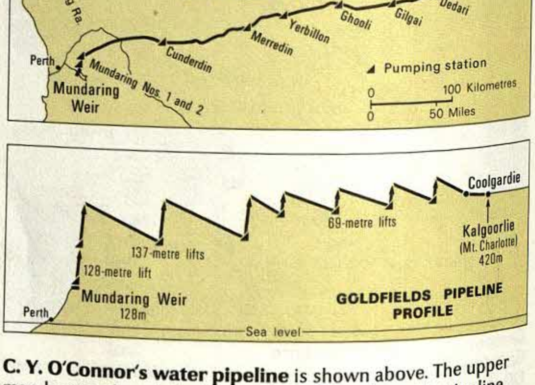
O'Connell was born in Cahirciveen, County Kerry. He became a lawyer in 1798. O'Connell formed the Catholic Association in 1823 to seek the political rights of Catholics. In Parliament, he played a key role in the passing of the Reform Act of 1832, which gave most men of the middle class the right to vote. He was arrested in 1843 for supporting a campaign demanding Ireland's complete independence from Britain. In 1844, he was convicted of plotting against the government and spent 14 weeks in jail.

O'Connor, C. Y. (1843-1902), was the engineer responsible for the scheme to supply fresh water to the goldfields of Western Australia by pipeline from a catchment area and storage dam 557 kilometres away. He designed and supervised the construction of a safe deepwater port at Fremantle. He also improved the rail services.

Early life. Charles Yelverton O'Connor was born in Gravelmouth, County Meath, in Ireland. He began his education at Waterford Endowed School and proceeded to Dublin University. At 16 years of age he was apprenticed to the chief engineer of the Waterford and Limerick Railways.

In 1865, O'Connor migrated to New Zealand, where he spent the next 25 years designing and building a variety of engineering works. During this period, he married Susan Letitia Ness, a Scot. In 1890, the government of Western Australia, under Premier Sir John Forrest, allocated 1500 pounds to secure the services of a skilled engineer to organize public works. The position was offered to O'Connor. He took up duties in 1891.

Fremantle Harbour. O'Connor's first major task as engineer in chief was to build a suitable harbour for the colony. At that time, ships calling at Fremantle tied up



C. Y. O'Connor's water pipeline is shown above. The upper map locates the original pumping stations along the pipeline. The profile map shows how much each station lifted the water.

Goldfields pipeline, designed by C. Y. O'Connor, carries water more than 557 kilometres from Mundaring Weir to Kalgoorlie in Western Australia. The pipeline was built between 1900 and 1902. O'Connor also improved the state's railways and designed Fremantle Harbour.

alongside a deepwater jetty. The mooring was unprotected and considered unsafe. Mail steamers bypassed Fremantle for Albany, and passengers and mail had to make an overland journey of 413 kilometres to Perth.

O'Connor recommended building a harbour inside the river mouth. To do so, a bar of rock obstructing the mouth had to be removed. All previous attempts to do this had failed, but O'Connor proposed blasting and removing the rock in stages. The harbour was formally declared open on May 4, 1897.

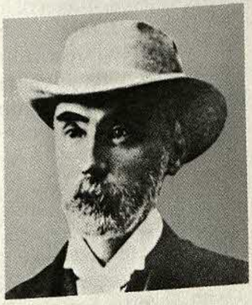
Railway expansion. O'Connor was also acting general manager for the Government Railways from 1891 to 1895. He pushed the Eastern Railway onward to Southern Cross in 1894, to service the Yilgarn goldfields. It was extended to Coolgardie in 1895, and in 1897, it reached Kalgoorlie.

Under his direction, the length of railways increased from 300 kilometres to 940 kilometres. A new railway station in Perth was completed in 1894.

When O'Connor took over, the railways had been running at a loss. By 1895 the railways were running at a considerable profit.

Goldfields Water Supply Scheme. The rich goldfields at Coolgardie, 557 kilometres from Perth, were discovered in 1892. Miners flocked to the area from all parts of Australia. The rapidly expanding population brought increasing demands for water. The supply was inadequate because of low rainfall and scarcity of underground water.

In 1896, authorities asked O'Connor to propose a comprehensive water scheme for the goldfields. His plan involved the construction of a reservoir on the Helena River in the Darling Ranges near Perth, 102 metres above sea level. From there, a series of eight pumping stations would pump 22,700 cubic metres of water daily through 557 kilometres of cast-iron pipes to a reservoir near Coolgardie, 457 metres above sea level. In September 1896, parliament, under Sir John Forrest, sanctioned a loan of 2 million pounds for the project. A commission of English engineers, appointed in 1897, inquired into the feasibility of the scheme.



C. Y. O'Connor

Work commenced early in 1898 with the foundations of the weir wall. Concreting began in February 1900, and the laying and jointing of pipes started in March 1901. The pumping of water commenced in April 1902 and followed each section of pipe as it was completed.

The actual time for the first water to reach Kalgoorlie from Mundaring Weir was 10 months, but normally it took about four weeks. The Goldfields Water Supply Scheme was officially opened at Coolgardie and Kalgoorlie on Jan. 24, 1903.

Untimely death. O'Connor did not live to see the Goldfields Water Supply Scheme succeed. His far-sighted plans had always met with criticism. He had been accused of extravagance with public money and of suggesting projects doomed to failure. The press continually attacked his character and this ultimately affected his health. On March 10, 1902, he went for his usual morning ride along the beach and shot himself only a month before the water from Mundaring Weir began to be pumped along the pipeline.

O'Connor, Feargus (1794-1855), became a leader of the *Chartist movement,* a national campaign for social and political reform in the United Kingdom in the 1830's. Feargus Edward O'Connor was born at Connorville, County Cork, Ireland. He was elected to the British Parliament in 1832. In 1837, he became publisher of the *Northern Star,* a radical Chartist newspaper. O'Connor became impatient with the moderate Chartist leaders, and, in 1841, he broke away and founded the National Charter Association. It proved unsuccessful.

O'Connor, Flannery (1925-1964), was an American author whose novels and stories are filled with terror and violence. Many of her characters are physically deformed or emotionally or spiritually disturbed. Some are obsessed with religion and the possibility of their own damnation or salvation. But O'Connor's books also contain humour, irony, and satire.

Mary Flannery O'Connor was born in Savannah, Georgia, U.S.A. Her Southern heritage and her Roman Catholicism strongly influenced her writing. She suffered from poor health most of her life and could complete only a few works. They include two novels, *Wise Blood* (1952) and *The Violent Bear It Away* (1960). Her stories were collected in *A Good Man Is Hard to Find* (1955) and *Everything That Rises Must Converge,* published in 1965 after her death. *Mystery and Manners,* essays and lectures on literature and writing, was published in 1969. A collection of her letters called *The Habit of Being* was published in 1979.

O'Connor, Frank (1903-1966), was the pen name of Michael O'Donovan, an Irish author who gained fame for his short stories about life in Ireland. Many of his stories are based on his childhood. He also produced works of criticism, published translations of Irish verse, and wrote many plays. He was born and educated in Cork.

O'Connor, Thomas Power (1848-1929), was an Irish journalist and politician who was a vigorous champion of Irish nationalism. He served in the British Parliament from 1880 to 1929.

O'Connor was born in Athlone, in County Westmeath. He started work as a reporter for a Dublin newspaper in 1867. He then founded and edited the London *Star*, the *Sunday Sun*, *T.P.'s Weekly*, and other papers. He also wrote books and articles.

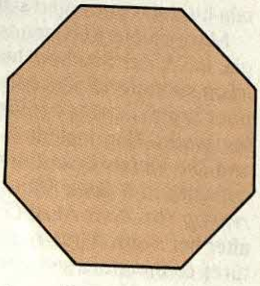
Ocotillo is a shrub that grows in the deserts of Mexico and southwestern United States. It is also called *candlewood, coachwhip,* and *vine cactus.*

The ocotillo plant stands 1.5 to 7.5 metres tall, and has many spiny stems growing out like switches from a base. After the wet season, the stems grow leaves and bunches of scarlet flowers. But in the dry season, they stand bare as dry thorny sticks.

Scientific classification. Ocotillo belongs to the fouquieria family, Fouquieriaceae. It is *Fouquieria splendens.*

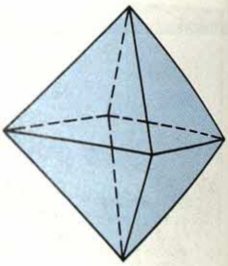
Ocotillo looks like a bunch of dry sticks thrust into the sand in dry periods. After a wet season, tiny green leaves cover the plant's long spines, and brilliant red blossoms form at the tips.

Octagon is a plane figure with eight sides. It is a type of polygon. The sides of an octagon meet at points called *vertices* to form eight interior angles. The interior angles of an octagon always add up to 1080°. A type of octagon called a *regular octagon* has equal sides and equal angles. The area of a regular octagon equals one-half the product of the perimeter and the *apothem,* the distance from the centre of a regular polygon to the midpoint of one of its sides.



A regular octagon, *above,* has eight equal sides.

Octahedron is any solid figure that has eight faces. It is a type of *polyhedron* (solid figure with many faces). The faces of an octahedron need not have the same shape. Some may be triangles and others another kind of polygon. A variety of octahedron called a *regular octahedron* is a convex polyhedron in which all of the eight faces are congruent to any given equilateral triangle.



A regular octahedron, *above,* has eight faces, each of which is congruent to any given equilateral triangle.

Octane is any of 18 chemical compounds that consist of 8 carbon atoms and 18 hydrogen atoms. Octanes are among the chief ingredients of petrol. An octane called *isooctane* is used in a test mixture to determine how well a petrol resists knocking (see **Octane number**). Petrol with a high octane number prevents engine knock better than one with a lower octane number.

Octanes belong to a group of chemicals called *hydrocarbons* (see **Hydrocarbon**). All octanes are colourless liquids, all are highly flammable, and all have the same molecular formula, C_8H_{18}. However, they have different molecular structures and therefore different chemical and physical properties. For example, *normal octane,* also called *n-octane,* boils at 125.7° C, but isooctane boils at 99.2° C.

Octane number is a number that tells how well a motor fuel resists "knocking." "Knocking" occurs when the last of the fuel in an engine cylinder burns too soon or too fast. The octane number of a motor fuel is found by comparing the fuel's knocking tendency with that of *reference fuels* in a test engine. Each reference fuel is a blend of *normal heptane* (a knock-prone fuel) and *isooctane* (a knock-resistant fuel). Normal heptane has an octane number of zero, and isooctane a value of 100. A motor fuel has an octane number of 85 if it produces the same knock as a reference fuel made of 85 per cent isooctane and 15 per cent normal heptane. Most petrols have octane numbers from 80 to 100. See also **Petrol; Tetraethyl lead.**

Octave, in music. See **Music** (Musical terms).

Octavia (69?-11 B.C.) was the older half-sister of the Roman ruler Octavian, who became the emperor Augustus in 27 B.C. Octavia married Octavian's co-ruler Mark Antony in 40 B.C. The marriage sealed a peace pact that ended a civil war between Octavian and Antony. Octavia bore Antony two daughters, Antonia the Elder and Antonia the Younger.

Antony treated Octavia badly. He had fallen in love with Cleopatra, queen of Egypt, before he married Octavia. In 37 B.C., Antony left Octavia to live with Cleopatra. He divorced Octavia in 32 B.C. Afterward, Octavia brought up Antony's children by his first wife, Fulvia, in addition to her own children by Antony and her first husband, Marcellus. Octavia also raised Antony's children by Cleopatra after Antony and Cleopatra died in 30 B.C.

See also **Antony, Mark; Augustus; Cleopatra.**

Octavian. See **Augustus.**

Octillion. In the United Kingdom, an octillion is 1 followed by 48 zeros. In France and the United States, it is 1 with 27 zeros. See also **Decimal system** (The decimal system and number words).

October is the 10th month of the year according to the Gregorian calendar, which is used in almost all the world today. Its name comes from the Latin word for *eight.* October was the 8th month in the early Roman calendar. It later became the 10th month when the ancient Romans moved the beginning of the year from March 1 to January 1. October has had 31 days since the time of the Roman emperor Augustus.

In temperate lands of the Northern Hemisphere, the first frost usually occurs in October. Farmers must finish harvesting most crops, but the cold weather does not come to stay. Days of warm, hazy sunshine still appear. They inspired poets to sing the praises of October and the arrival of autumn. Leaves change to brilliant crimson, russet, and gold. In the temperate regions of the Southern Hemisphere, October heralds the end of the cool winter season and the approach of spring.

Activities. Farmers harvest October crops and store them or transport them to market. A few fruits, such as apples and grapes, are still on trees and vines in some areas. Many apples are harvested at the end of October. An old English name for October was *Winmonath,* or "wine month", for this was the season of wine-making.

Special days. National holidays in October include Thanksgiving Day in Canada, on the second Monday of the month. China celebrates its national day, which marks the foundation of the Communist republic in 1949, on Oct. 1. On Oct. 12, 1492, Christopher Columbus and his ships arrived in the New World, and this event is commemorated by Americans on Columbus Day, on the second Monday in October. In South Africa, Oct. 10 is Kruger Day, in honour of the birthday of the Boer leader

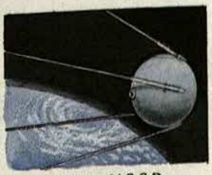
Important October events

1 First "Model T" Ford car put on the market, 1908.
— Jimmy Carter, U.S. president, born 1924.
— China's national day, marking the foundation of the Communist republic in 1949.
2 Mohandas Gandhi, Indian political leader, born 1869.
3 Eleonora Duse, Italian actress, born 1859.
4 Painter Jean François Millet born 1814.
— American artist Frederic Remington born 1861.
— The Soviet Union launched first artificial satellite, 1957.
5 Gregorian calendar introduced, 1582.
— Denis Diderot, French author, born 1713.
6 Jenny Lind, Swedish singer, born 1820.
— George Westinghouse, American inventor, born 1846.
— Le Corbusier, Swiss-born architect, born 1887.
— Anwar el-Sadat, president of Egypt, assassinated 1981.
7 James Cook, British navigator, sighted the coast of New Zealand, 1769.
— Niels Bohr, Danish physicist, born 1885.
8 In the United States, the Chicago fire began, and burned for about 30 hours, 1871.
9 Camille Saint-Saëns, French composer, born 1835.
10 Henry Cavendish, English scientist, born 1731.
— Giuseppe Verdi, Italian opera composer, born 1813.
— Norwegian explorer and statesman Fridtjof Nansen born 1861.
— Helen Hayes, American actress, born 1900.
11 Arthur Phillip, first governor of New South Wales, Australia, born in London, 1738.
— Eleanor Roosevelt, wife of U.S. President Franklin D. Roosevelt, born 1884.
— François Mauriac, French novelist, born 1885.
12 Columbus landed in America, 1492.
— James Ramsay MacDonald, first Labour prime minister of Britain, born 1866.
12 Ralph Vaughan Williams, British composer, born 1872.
13 Rudolf Virchow, German scientist, born 1821.
— British prime minister Margaret Thatcher born 1925.
14 William the Conqueror won the Battle of Hastings, which assured the Norman conquest of England, 1066.
— William Penn, founder of Pennsylvania, born 1644.
— Eamon de Valera, president of the Irish Republic, born 1882.
— Dwight D. Eisenhower, U.S. president, born 1890.
— E. E. Cummings, American poet, born 1894.
— American pilot Charles Yeager became the first person to fly faster than sound, piloting the Bell X-1 plane, 1947.
15 Virgil, Roman poet, born 70 B.C.
— J. F. Pilâtre de Rozier became first person to make an ascent in a captive balloon, 1783.
— Philosopher Friedrich Nietzsche born 1844.
16 Dictionary editor Noah Webster born 1758.
— Oscar Wilde, Irish-born dramatist, born 1854.
— David Ben-Gurion, Israeli prime minister and Zionist leader, born 1886.
— Eugene O'Neill, American playwright and Nobel Prize winner, born 1888.
17 British general John Burgoyne surrendered his army to the Americans at Saratoga, 1777.
— American antislavery campaigner John Brown and his men seized the United States arsenal at Harpers Ferry, Virginia, U.S.A., 1859.
18 Henri Bergson, French philosopher, born 1859.
— Sidney George Holland, New Zealand prime minister, born 1893.
— Pierre Elliott Trudeau, prime minister of Canada, born 1919.
19 British troops under Cornwallis surrendered to the Americans at Yorktown, 1781.

Oct. birthstone— opal

Oct. 1—first "Model T" Ford

Oct. 2—Mohandas Gandhi born


Oct. 4—U.S.S.R. launch Sputnik

Paul Kruger. The Indian festival of Diwali, the first day of the Hindu New Year, falls in late autumn, often in October. On the evening of Halloween, the last day of October, children in some countries disguise themselves with masks and costumes and go from door to door asking for a treat.

October symbols. The calendula is the special flower for October. The birthstones for this month are the opal and the tourmaline.

Quotations

October turned my maple's leaves to gold;
The most are gone now; here and there one lingers;
Soon these will slip from out the twig's weak hold,
Like coins between a dying miser's fingers.
Thomas Bailey Aldrich

There is something in October sets the gipsy blood astir;
We must rise and follow her,
When from every hill of flame
She calls, and calls each vagabond by name.
Bliss Carman

October gave a party;
The leaves by hundreds came;
The ashes, oaks, and maples,
And those of every name.
George Cooper

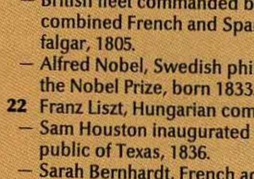
Related articles in *World Book* include:

Autumn	Calendula	Opal
Calendar	Halloween	Tourmaline

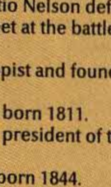
October Revolution. See Union of Soviet Socialist Republics (History).

Important October events

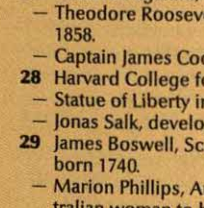
19 Thomas Edison began first successful demonstration of his electric light, 1879.
20 Architect Sir Christopher Wren, designer of St. Paul's Cathedral, London, born 1632.
— John Dewey, American philosopher and educator, born 1859.
— Allied forces landed to begin the liberation of the Philippines, in World War II, 1944.
21 Portuguese navigator Ferdinand Magellan entered strait at the southern tip of South America that bears his name, 1520.
— Hokusai, Japanese artist, born 1760.
— Samuel Taylor Coleridge, English poet, born 1772.
— British fleet commanded by Horatio Nelson defeated a combined French and Spanish fleet at the battle of Trafalgar, 1805.
— Alfred Nobel, Swedish philanthropist and founder of the Nobel Prize, born 1833.
22 Franz Liszt, Hungarian composer, born 1811.
— Sam Houston inaugurated as first president of the Republic of Texas, 1836.
— Sarah Bernhardt, French actress, born 1844.
23 Pelé (Edson Arantes do Nascimento), Brazilian soccer player, born 1940.
— British began offensive at El Alamein in Egypt in World War II, 1942.
— Battle for Leyte Gulf in the Philippines began in World War II, 1944.
24 Anton van Leeuwenhoek, Dutch microscopist and naturalist, born 1632.
— United Nations formally established when necessary number of members ratified charter, 1945.
25 Henry V of England defeated French at Agincourt in Hundred Years' War, 1415.
25 Dirck Hartog landed on an island off the coast of Western Australia, 1616.
— Thomas B. Macaulay, English historian, born 1800.
— "Waltz King" Johann Strauss, Jr., born 1825.
— Georges Bizet, French composer, born 1838.
— Battle of Balaklava in the Crimean War, 1854.
— Spanish painter Pablo Picasso born 1881.
— Richard E. Byrd, American explorer of the North and South poles, born 1888.
26 Helmuth von Moltke, Prussian general, born 1800.
— Erie Canal opened to traffic, 1825.
— French statesman Francois Mitterand born 1916.
27 Niccolò Paganini, Italian violinist, born 1782.
— Theodore Roosevelt, United States president, born 1858.
— Captain James Cook, English explorer, born 1728.
28 Harvard College founded in America 1636.
— Statue of Liberty in New York harbour dedicated, 1886.
— Jonas Salk, developer of a polio vaccine, born 1914.
29 James Boswell, Scottish biographer of Samuel Johnson, born 1740.
— Marion Phillips, Australian economist and the first Australian woman to be elected to the British House of Commons, born 1881.
— Blackest day in stock market history, 1929.
30 John Adams, U.S. president, born 1735.
— Benito Mussolini, founder of fascism, became premier of Italy, 1922.
31 Martin Luther nailed his 95 theses to the door of a church at Wittenberg, 1517.
— Jan Vermeer, Dutch painter, born 1632.
— John Keats, English poet, born 1795.
— Sir Hubert Wilkins, Australian explorer, born 1888.
— Indian leader Indira Gandhi assasinated 1984.



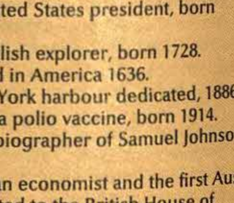
Oct. 12—Columbus' arrival in America



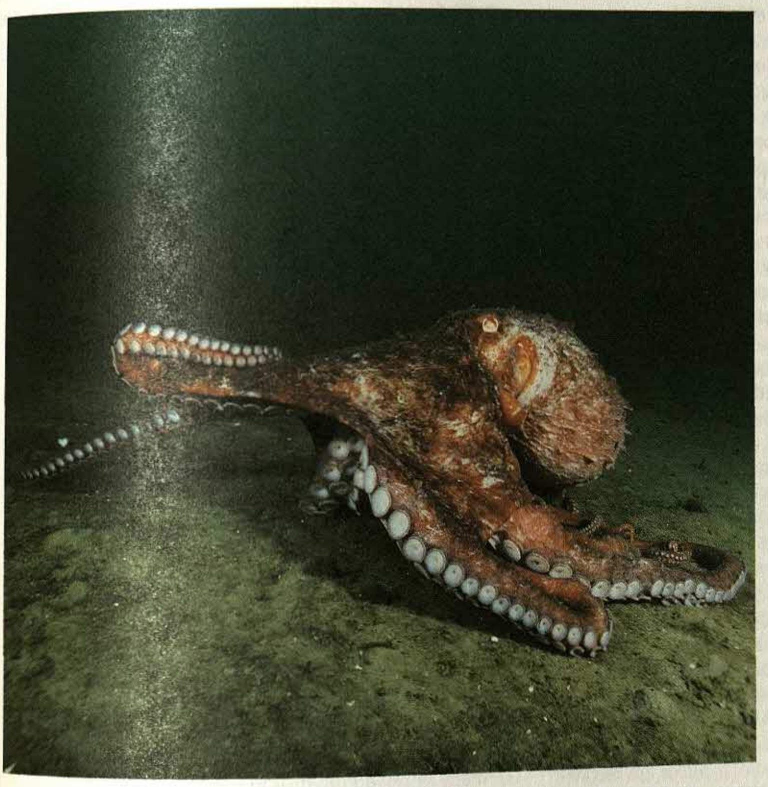
Oct. 14—Eamon de Valera born



Oct. 15—first manned balloon ascent



Oct. 21—Battle of Trafalgar



Octopuses are soft-bodied sea animals with eight long arms. Muscular suckers on the underside of each arm enable an octopus to cling tightly to rocks or prey. There are about 100 species of octopuses. The *giant octopus, left,* lives in the Pacific Ocean. The photographs on the right show a cluster of transparent octopus eggs, *top,* and a newly hatched octopus.

Octopus is a sea animal with a rounded body, large eyes, and eight long arms. There are about 100 species of octopuses. The best-known species inhabit rocky, sandy, or muddy bottoms in shallow parts of oceans throughout the world. Other octopuses live in deep waters.

Octopuses vary greatly in size. The largest species, the *giant octopus* of the Pacific Ocean, weighs as much as 50 kilograms. It measures more than 6 metres from the tip of one arm to the tip of another on the opposite side of the body. The smallest species, found in the Indian Ocean, weighs less than 28 grams and measures about 2.5 centimetres from arm tip to arm tip.

Octopuses belong to a group of animals called *molluscs.* This group also includes clams, oysters, and snails. Like squids and cuttlefish, octopuses are molluscs that have no outside shell.

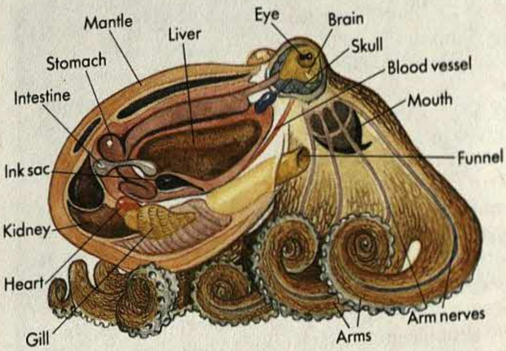
The body of an octopus is soft and boneless. A fleshy, muscular covering, called the *mantle,* surrounds the main part of the body, forming a cavity that encloses the gills.

An octopus breathes by drawing water into the mantle cavity. The circulation of water provides oxygen for the gills. The mantle then contracts and forces the water out through a tube called the *funnel* or *siphon.* An octopus has three hearts. Two hearts are associated with the gills and are called *gill hearts.*

The two eyes of an octopus are on each side of the head. They are similar in structure to the eyes of human beings and provide good vision.

Eight arms extend from the head of an octopus. At their base, the arms are united by a membrane web. The underside of each arm is lined with round, muscular suckers. An octopus uses its arms and suckers to move along the ocean bottom and to capture the small

The body of an octopus



animals that it eats. The suckers can provide enormous suction, enabling the octopus to attach firmly to rocks. If an octopus loses an arm, a new one grows in its place. An octopus's mouth is a beaklike structure located beneath the head at the base of the arms.

The life of an octopus. Octopuses feed chiefly on crabs, clams, and snails. Many species also eat other octopuses. Certain octopuses make a hole in the shell of prey and inject a poison that paralyses the animals.

Many sea animals—especially seals, whales, and certain fish—prey on octopuses. An octopus has various means of avoiding predators. It can swim quickly backward by forcing a powerful jet of water through its funnel. The octopus may conceal itself by discharging a cloud of inky fluid. In some cases, the shape of the ink cloud resembles the octopus and thus acts as a decoy.

An octopus also can escape danger by rapidly changing colour. Its skin contains cells called *chromatophores,* each of which contains a single-coloured pigment. When the octopus is excited, these cells contract or expand, producing a colour change that can startle a predator or help camouflage the octopus.

Octopuses reproduce sexually. The female octopus can lay more than 100,000 eggs. She cares for the eggs until they hatch into tiny, immature octopuses. The young swim at or near the surface of the water for several weeks as part of *plankton* (see **Plankton**). Many of the young are eaten by fish and other marine animals.

Octopuses have short lives. Many live one year or less. The largest species live about three years.

Octopuses and people. Most octopuses are not regarded as dangerous to human beings. However, octopuses sometimes bite, so caution is necessary in handling them. In some countries, octopus is an important food. There are octopus fisheries in many parts of the world, most notably off Japan, in the Mediterranean, and off the northwest coast of Africa.

Scientific classification. Octopuses make up the order Octopoda in the class Cephalopoda and the phylum Mollusca. Many species belong to the genus *Octopus.*

See also **Cuttlefish; Mollusc; Nautilus; Squid.**

Ocular. See **Microscope; Telescope.**

Oculist is a doctor who treats eye disorders and diseases. See **Ophthalmology.**

Ó Dálaigh, Cearbhall (1911-1978), was president of the Republic of Ireland from 1974 to 1976. Before becoming president, Ó Dálaigh had been a judge of the European Court of Justice, in Luxembourg (1973-1974). From 1961 to 1973, he was chief justice and president of the Supreme Court of Ireland. Ó Dálaigh was born in Bray, County Wicklow, and educated at University College, Dublin. From 1931 to 1942, he was editor of the *Irish Press.* He was called to the Bar in 1934. Ó Dálaigh served as attorney general from 1946 to 1948 and from 1951 to 1953. He became a judge in 1953.

Ode is a poem of moderate length that usually expresses exalted praise. Greek dramatists wrote *choral odes* that had three parts. Two parts, a *strophe* and an *antistrophe,* had identical metre. The third part, called an *epode,* had a contrasting metre. Pindar, of ancient Greece, wrote odes in praise of athletic heroes. He used the strophic form, which came to be called *Pindaric* (see **Pindar**). Horace, of ancient Rome, wrote odes made up of uniform stanzas, called *stanzaic* form.

English poetry, from the time of Ben Jonson, included a variety of Pindaric odes, stanzaic odes, and *irregular* odes, or those with no particular stanza structure. John Dryden wrote two irregular odes in praise of St. Cecilia. "Ode to Evening," by William Collins, is a notable stanzaic ode. The great irregular and stanzaic odes of the 1800's include William Wordsworth's "Ode: Intimations of Immortality," Percy Bysshe Shelley's "Ode to the West Wind," and John Keats' "Ode on a Grecian Urn"

See also **Greek literature** (Lyric poetry).

Oder River is an important waterway in central Europe. It is about 855 kilometres long and drains about 119,000 square kilometres.

The Oder, also called Odra, rises in the Sudetes Mountains of the Czech Republic. It then flows northward across western Poland where it is joined by the Neisse (Nysa) River—officially Lausitzer Neisse (Nysa Łużycka). The joined rivers form most of the boundary between Poland and Germany. The Oder empties into the Baltic Sea by way of the Stettin Lagoon (see **Poland** [terrain map]). Oceangoing vessels use the Polish port of Szczecin south of the lagoon.

The Oder's tributaries include the Warta (Warthe) River. The Warta links the Oder with the Vistula River in Poland by means of the Noteć (Netze) River and a canal. Canals also link the Oder with the Polish city of Gliwice and with the Havel and Spree rivers in Germany.

The Oder-Neisse boundary between Poland and Germany was established after World War II ended in 1945. East Germany recognized this boundary in 1950. West Germany opposed the boundary until 1970, when it signed treaties with both Poland and the Soviet Union confirming the boundary.

Odessa (pop. 1,106,000) is a seaport city in Ukraine. It lies on the southwestern coast of Ukraine, near the Romanian border. Odessa is on the Black Sea, 51 kilometres southwest of the mouth of the Dnepr River. For the location of Odessa, see **Ukraine** (map).

Odessa is one of Ukraine's industrial centres. Its refineries produce large amounts of petroleum products, and its factories make machinery, cars, aeroplanes, and film equipment. Odessa is built in a circular shape and slopes down toward the harbour, which serves as an important transfer point for rail and ocean transportation. A long, spectacular stairway leads up from the harbour. The city is also known for its health resorts.

Historians are not sure when the first settlement was established on the site where Odessa now stands. The area was conquered by the Tatars in the 1200's, followed by the Lithuanians in the 1300's and the Ottomans in the 1500's. Russia gained control in 1792 and built a port and a fortress there. In 1795, Russia named the city Odessa. In 1944, Odessa became part of the Ukrainian Soviet Socialist Republic of the Soviet Union. In 1991, prior to the break-up of the Soviet Union, the Ukrainian republic declared itself an independent nation.

Odets, Clifford (1906-1963), an American dramatist, is best known for his plays of social conflict written during the 1930's. His most successful works were presented by the famous Group Theatre.

Odets' one-act play *Waiting for Lefty* (1935) is about a taxi drivers' strike. It ranks among the most important of the many plays written in the 1930's that deal with the struggle of the working class. Odets' *Awake and Sing!*

(1935) tells the story of a poor Jewish family in the Bronx during the Depression. It is less propagandistic than *Waiting for Lefty,* and its style has been compared to the style in Anton Chekhov's plays. Odets also wrote *Paradise Lost* (1935), *Golden Boy* (1937), *The Big Knife* (1948), and *The Country Girl* (1950).

Odets was born in Philadelphia. He helped form the Group Theatre in 1931. He worked as a film scriptwriter from 1936 until shortly before his death.

Odin was the chief god in Norse mythology. He is also called Wotan. Odin became the ruler of the universe after he and his two brothers, Ve and Vili, killed the frost giant Ymir, the first living being. From Ymir's huge body, they made Midgard, the earth; and began to build Asgard, the dwelling place of the gods.

Valhalla was the home of Odin in Asgard. There he feasted with the souls of heroes who had died in battle. Odin, a fearless fighter, carried a spear as his special weapon and rode an eight-legged horse named Sleipnir.

Odin was also the wisest god. He gave up one of his eyes for the right to drink from the spring of wisdom, guarded by Mimir, the water demon. Odin was also known for his magic powers. By wounding and hanging himself from a tree, he acquired the power of spells called *runes.* They enabled him to predict the future, change his shape at will, and visit the underworld. Odin had many sons. They included Thor, the god of thunder, and Balder, the god of goodness and harmony.

According to Norse myths, Odin will lead the gods against the evil giants at Ragnarok, the battle that will destroy the world. He will be eaten by Fenrir, a ferocious wolf.

The Anglo-Saxons' name for Odin was Woden. It was the source of the word *Wednesday.*

See also **Mythology** (Teutonic mythology); **Valhalla.**

Odoacer (A.D. 434?-493) was the Germanic leader who overthrew the last emperor of Rome in the West, ending the West Roman Empire.

Odoacer was probably born near the Danube River in what is now Germany. He joined the West Roman army and became a leader of barbarian troops serving the Romans. In 476, when the Roman government refused to give his troops land for settlement, Odoacer led them in a revolt. He deposed the West Roman emperor, Romulus Augustulus, and became the first barbarian king of Italy. Historians consider this event the end of the West Roman Empire. But for years, barbarian generals had been its real rulers. The emperors were symbolic rulers.

Odoacer ruled independently, although he pretended to serve Zeno, the East Roman emperor. Zeno never recognized Odoacer as ruler of Italy. In 489, Zeno sent the Ostrogoth king Theodoric to attack Odoacer. Odoacer retreated to Ravenna, where he surrendered in 493 and was executed (see **Theodoric**).

Odonata. See **Insect** (table; pictures: Order Odonata).

O'Donnell, Hugh Roe (1571?-1602), took a leading part in the Irish resistance to English rule in the late 1500's. On becoming Lord of Tyrconnel, he agreed to accept English rule. But he conspired with the Spaniards and aided other rebellious Irish chieftains. After the Battle of Kinsale, O'Donnell went to Spain, where he died.

Odour. See **Smell.**

O'Dowd, Bernard (1866-1953), an Australian poet, was widely acclaimed in his time. He did much to free Australian poetry from the tradition of the bush ballad and the outdated philosophies of the 1800's. A man of wide reading and learning, O'Dowd was deeply influenced by the American poet Walt Whitman. The three aspects of his poetry are his humanitarianism, his faith in the individual, and his strong belief in Australia and its future. He believed that poetry was useless if not concerned with society. This belief inspired his sociological verse. His lyrical power is evident in his prophetic nationalistic verse. His best poem is "The Bush" (1912). O'Dowd was born in Beaufort, Victoria.

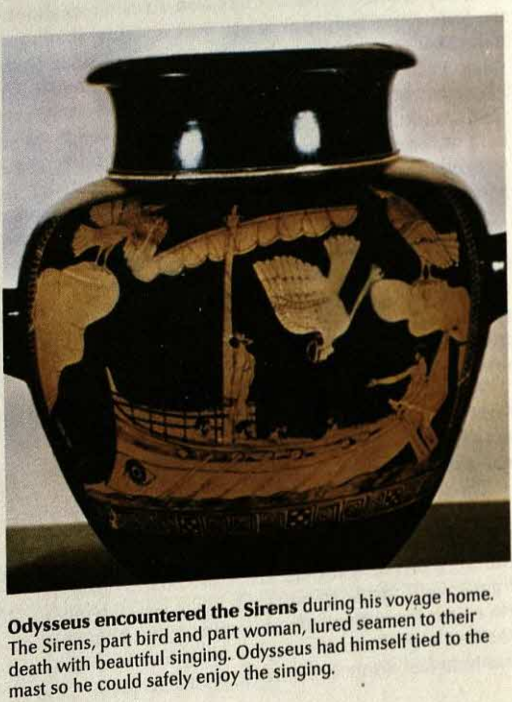
Odysseus. See **Ulysses.**

Odyssey, an epic poem, is perhaps the most influential and most popular work in ancient Greek literature. The *Odyssey* ranks among the greatest adventure stories in literature. It became a model for many later adventure stories.

According to tradition, the *Odyssey* was composed by the Greek poet Homer, probably in the 700's B.C. The central character is Odysseus (Ulysses in Latin), the king of Ithaca. The poem describes Odysseus' journey home after fighting for Greece against the city of Troy in the Trojan War. The author wrote about this war in the *Iliad,* another great epic poem. See **Homer.**

The *Odyssey* consists of 24 *books* (sections). The story takes place during a period of about 10 years. The tale begins after much of the action has already occurred. This device of starting a story in the middle and returning to the start is called *in medias res.* Many later writers used it.

The *Odyssey* begins on the island of Ogygia, where Odysseus has been the prisoner of the sea nymph Calypso for seven years. At a council of the gods on Mount Olympus, Zeus decides the time has come for Odysseus to return to his wife, Penelope, in Ithaca.



Odysseus encountered the Sirens during his voyage home. The Sirens, part bird and part woman, lured seamen to their death with beautiful singing. Odysseus had himself tied to the mast so he could safely enjoy the singing.

The scene then changes to Odysseus' palace in Ithaca, where a group of unruly young noblemen has settled. The noblemen want Penelope to assume that her husband is dead. They demand that she marry one of them and thus choose a new king of Ithaca. Odysseus' son, Telemachus, resents the noblemen. The goddess Athena suggests that he go on a journey to seek news of his father. Telemachus agrees and leaves Ithaca.

The tale next returns to Odysseus' adventures. The god Hermes makes Calypso release Odysseus. Odysseus sails away on a raft, but the sea god Poseidon causes a storm and he is shipwrecked on the island of the Phaeacians. Nausicaa, the beautiful daughter of the Phaeacian king, discovers him.

Odysseus describes his wanderings since the Trojan War while being entertained by the Phaeacians. He tells of his visit to the land of the lotus-eaters, whose magic food makes people forget their homeland. Some of his men who ate the food wanted to stay with the lotus-eaters, but Odysseus forced them to leave with him. Odysseus and his men then sailed to an island where they were captured by Polyphemus, a one-eyed giant called a *Cyclops.* They escaped after blinding the Cyclops with a heated stake. But the Cyclops prayed to his father, Poseidon, to avenge him by making Odysseus' homecoming as difficult as possible.

After more adventures, the ship carrying Odysseus and his men landed on the island of the enchantress Circe. Circe changed Odysseus' men into pigs and made Odysseus her lover. She told Odysseus that to get home, he must visit the underworld to consult the prophet Teiresias. In the underworld, Odysseus saw the ghosts of his mother and of Trojan War heroes. He also witnessed the punishment of sinners.

Teiresias warned Odysseus of the dangers awaiting him, and Circe told him how to sail past the sea monsters Scylla and Charybdis. Circe also warned him about the Sirens, sea nymphs who use their beautiful singing to lure sailors to death on a magic island. Odysseus' ship sailed past these dangers and seemed ready to reach Ithaca without further trouble. But some of Odysseus' men stole and ate the sacred cattle of the sun on the island of Thrinacia. As punishment, the ship was destroyed by a thunderbolt and the men drowned. Odysseus was washed up on Ogygia, where the story began.

Odysseus returns home. After Odysseus finishes his story, the Phaeacians take him to Ithaca. Athena tells him of the noblemen in his palace and advises him to return home in disguise. Odysseus goes to his palace disguised as a beggar. Penelope has agreed to marry the man who can string Odysseus' huge bow and shoot an arrow through 12 axes.

The *Odyssey* as literature. The *Odyssey* is a skilfully written adventure story. The story combines realistic accounts of life in ancient Greece and elements of historical events with fairy tales about imaginary lands.

The work also contains skilful characterization. Odysseus represents the model of a man of courage and determination. In spite of many setbacks, he never abandons his goal of returning home. But he has other human traits that keep him from being only a symbol. He enjoys life, even while struggling to get home. He is restless, clever, and even tricky and is able to invent lies easily. In fact, some later Greek dramatists made Odysseus a symbol of deceit. Penelope stands for the faithful, loving wife. Telemachus symbolizes the youth who matures by facing a difficult challenge. The travels of Odysseus and Telemachus may represent the human journey through life and the search for self-fulfilment and self-knowledge.

Related articles in ***World Book*** include:

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Aeolus
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Circe
Cyclops
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Iliad
Lotus-eater
Penelope
Scylla
Sirens
Ulysses

Oedema is the swelling of body tissues caused by build-up of fluid in the spaces between cells.

Oedema may be *local*—that is, limited to one part of the body—or it may affect tissues throughout the body. Local oedema commonly results when injured capillaries leak their contents into nearby tissue spaces.

The most common cause of general oedema is heart failure. When a weak heart does not circulate the blood effectively, the kidneys cannot remove enough water and salt from the bloodstream. As a result, the blood volume increases and excess liquid seeps into the body tissues, particularly the legs and lungs. The condition is called *pulmonary oedema* when excess fluid accumulates in the lungs, causing shortness of breath. Doctors treat oedema due to heart failure with drugs or surgery to improve heart function. Patients also receive *diuretics,* drugs that increase the amount of water and salt eliminated by the kidneys.

General oedema also frequently results if poor diet, liver disease, or kidney disease causes a drop in the protein content of the blood plasma. Proteins in the blood plasma play a major role in the blood's ability to retain fluid. High-protein diets help to correct this type of oedema.

Problems with lymphatic drainage cause *lymphoedema.* This condition often requires long periods of bed rest, with the affected body parts elevated and tightly wrapped to reduce swelling.

Oedipus was a king of Thebes in Greek mythology. He unknowingly killed his father and married his mother. Many ancient authors wrote different versions of the story of Oedipus. The following version is based largely on *Oedipus Rex,* a tragedy by the Greek playwright Sophocles.

The *oracle* (prophet) of Delphi told King Laius of Thebes that a son born to his wife, Queen Jocasta, would kill him (see **Delphi**). After Jocasta gave birth to a son, Laius ordered the baby put to death. However, a shepherd rescued the child and brought him to King Polybus of Corinth. Polybus adopted the boy and named him *Oedipus.*

Oedipus grew up in Corinth. As a young man, he learned from the oracle that he would kill his father and marry his mother. Believing that Polybus was his father, Oedipus tried to avoid the prophecy by fleeing Corinth. On the road to Thebes, he quarrelled with a man and killed him. The stranger was King Laius.

Near Thebes, Oedipus encountered a monster called the Sphinx. She had a woman's head, a lion's body, and a bird's wings. The Sphinx killed everyone who could not solve this riddle: What has one voice and becomes four-footed, two-footed, and three-footed? The Sphinx asked Oedipus the riddle, which no one had solved. He answered: Man, who crawls on all fours as a baby, then walks on two legs, and finally needs a walking stick in old age. The Sphinx killed herself because Oedipus had solved the riddle. Oedipus was rewarded by being made king of Thebes. He married Jocasta.

Several years later, a plague struck Thebes. The oracle said it would end when the murderer of Laius had been driven from Thebes. Oedipus investigated the murder and came to realize that Laius was the man he had killed on the road to Thebes. He then discovered that Laius was his father and Jocasta his mother. Oedipus blinded himself, and Jocasta hanged herself.

Oedipus was banished from Thebes. He died at Colonus, near Athens. King Theseus of Athens had promised him a decent burial there because his spirit would protect the area from harm.

Oedipus complex, a concept used in psychoanalysis, is a child's unconscious desire for the exclusive love of the parent of the opposite sex. This desire includes jealousy toward the parent of the same sex and the unconscious wish for that parent's death.

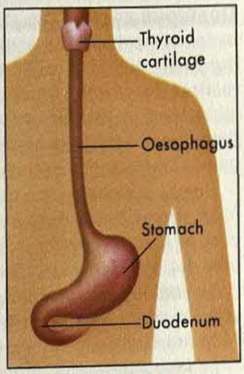
The term *Oedipus complex* was first used by the Austrian psychiatrist Sigmund Freud. It comes from the myth of Oedipus, a Greek hero who unknowingly killed his father and married his mother (see **Oedipus**). Freud used the term to describe the unconscious feelings of children of both sexes toward their parents. However, later researchers used the term *Electra complex* for the complex in girls. According to Greek legend, a woman named Electra helped plan the murder of her mother.

Freud believed that the Oedipus complex is a normal part of human psychological growth. The Oedipal phase of development is commonly considered to last from the age of $2\frac{1}{2}$ to 6. During this period, children experience intense feelings—love and hate, yearning and jealousy, fear and anger—that produce emotional conflicts. Most people outgrow the Oedipal phase, but some mentally ill individuals have a strong Oedipus complex as adults. According to Freud, the principal reason for the weakening of the complex in boys is the fear of punishment from the father.

Freud thought that all peoples experience the Oedipus complex. But many anthropologists and researchers in psychoanalysis doubt that the complex exists in certain non-Western societies. They believe it develops as a result of a person's social environment and does not occur in everyone.

Oersted is a unit used mainly to express the intensity of strength of a magnetic field caused by an electric current in a wire. One oersted equals 79.58 amperes per metre (see **Ampere**). The unit was named after Hans Christian Oersted, a Danish physicist who pioneered in the study of electromagnetism. It belongs to the Gaussian system of units, but is not in the more commonly used International System.

Oersted, Hans Christian (1777-1851), a Danish physicist and chemist, laid the foundation for the science of electromagnetism (see **Electromagnetism**). In 1820, he noticed that the needle of a compass wavered every time he put it near a wire carrying a current. He had discovered that every conductor carrying an electric current is surrounded by a magnetic field. Oersted is also credited with producing the first aluminium, in 1825 (see **Aluminium** [The first aluminium]). He wrote *Spirit of Nature* (1850). Oersted was born in Rudkøbing, Denmark.



The oesophagus connects the throat with the stomach.

Oesophagus, also called *gullet,* is the muscular canal that carries food from the lower part of the pharynx to the stomach. The muscles in the walls of the oesophagus produce wavelike contractions, moving the food down to the stomach. Mucus made by glands in its walls helps the movement of food by keeping the surface of the oesophagus moist and slippery.

The human oesophagus is about 25 centimetres long. The length varies greatly in different animals. The oesophagus of fish is short, while that of the giraffe is very long. Birds have a saclike part of the oesophagus called the *crop,* for the temporary storage of food.

See also **Alimentary canal; Digestive system; Human body** (Trans-Vision picture); **Stomach.**

Oestrogen is any of a group of chemically similar hormones that cause the growth and development of female sexual characteristics in human beings and other animals. Oestrogens also influence the female reproductive cycle. Of the several forms of oestrogen produced in a woman's body, *oestradiol* is the strongest.

During a girl's preteen or early teenage years, her ovaries begin to secrete increasing amounts of oestrogens into the bloodstream. Oestrogens cause the girl to develop breasts and rounded hips and cause the genital organs to enlarge and mature. Oestrogens also stimulate the lining of the uterus to thicken. The hormone *progesterone* limits this growth. The amount of oestrogens secreted by the ovaries changes during the menstrual cycle. As the woman grows older, her ovaries secrete smaller amounts of oestrogens. After the level of oestrogens in the blood becomes too low to stimulate the uterine lining, menstruation no longer occurs. At this stage, the woman is said to have reached *menopause.*

In both women and men, small amounts of oestrogens are produced in fat tissue, muscles, and many other parts of the body. In males, the *testes* (sex organs) also produce oestrogens. The function of oestrogens in the male is unclear.

The drug industry produces synthetic oestrogens for use in birth control pills and for certain types of medical therapy. Use of large amounts of synthetic oestrogens may be harmful to some patients. For example, the use of birth control pills has been associated in some women with blood clots, high blood pressure, and diabetes. Women who take oestrogen without progesterone are at increased risk of cancer of the *endometrium* (inner lining of the uterus). After menopause, many women require treatment with oestrogens to prevent loss of calcium from bones, to maintain a healthy vaginal lining, and to reduce risk of heart disease. Such treatment is safe at properly prescribed dosages.

See also **DES; Hormone** (Growth and sex hormones); **Menopause; Menstruation; Oestrous cycle; Steroid.**

Oestrous cycle is the process that prepares the females of most species of mammals for mating and bearing young. It is also called the *breeding cycle.* Among many mammals, the oestrous cycle occurs during a certain period, called the *breeding season.* The cycle is timed so that the young are born at the time of year when they have the best chance of survival.

During the oestrous cycle, a period called *oestrus,* or *heat,* occurs. The female is sexually excited throughout oestrus and, among most species of mammals, will mate only during this period. The length of both the oestrous cycle and oestrus varies among the species. In most rats, the cycle lasts about 4 days, and oestrus lasts about 14 hours. However, among most breeds of dogs, the cycle lasts about six months and oestrus lasts about three weeks.

Some mammals—human beings, apes, and some kinds of monkeys—do not have an oestrous cycle. The females of these species have a *menstrual cycle,* which prepares them to bear young (see **Menstruation**).

The oestrous cycle is regulated by (1) environmental conditions and (2) hormones.

Environmental regulation. Seasonal changes in several factors of the environment help trigger the oestrous cycle. These factors include the number of hours of daylight and the temperature. Among many species, the male produces certain odours and sounds that affect the female and help start the cycle.

The environmental changes stimulate the female's *hypothalamus,* a part of the brain, to secrete a substance called *gonadotropin-releasing hormone.* This substance stimulates the pituitary gland to secrete *follicle-stimulating hormone* (FSH) and *luteinizing hormone* (LH). FSH and LH prepare the female to mate and to bear young.

Hormonal regulation of the oestrous cycle has two phases, the *follicular phase* and the *luteal phase.*

During the follicular phase, the pituitary gland secretes an increased amount of FSH. This hormone causes *follicles,* tiny sacs in the ovary, to mature. Each follicle contains an *egg,* the female sex cell.

Near the end of the follicular phase, the pituitary also secretes an increased amount of LH. This stimulates the follicles to release the female sex hormones called *oestrogens.* Oestrogens cause the lining of the *uterus* (womb) to thicken, preparing the uterus to hold a baby animal during pregnancy. The additional LH also causes the mature follicles to release their eggs from the ovary. This release of eggs is called *ovulation.* The eggs then move to the uterus. If they are fertilized by *sperm,* the male sex cells, the eggs attach themselves to the lining of the uterus and begin to develop into baby animals.

Ovulation starts the luteal phase. During this phase, LH causes each empty follicle in the ovary to form a body of cells called a *corpus luteum* (plural, *corpora lutea*). The corpora lutea release *progesterone,* a female sex hormone that further prepares the uterus to hold the unborn young. Oestrus begins during or after ovulation.

If fertilization occurs, the oestrous cycle stops until the young have been born. If fertilization does not occur, the corpora lutea shrink. The thickened lining of the uterus is not needed for young, and the female's body absorbs this material.

See also **Reproduction.**

O'Faolain, Sean (1900-1991), became known as a leading Irish author. His ability as a writer of short stories won him wide acclaim. He also wrote a play, several novels, and historical biographies. His collections of short stories include *Midsummer Night's Madness* (1932), *A Purse of Coppers* (1937), and *The Talking Trees* (1971). His other works include *Come Back to Erin* (1940) and *The Great O'Neill* (1942). O'Faolain was born in Cork and educated at University College, Cork, and at Harvard University, in the United States.

Offa. See **Kings and queens of Britain and Ireland** (The Anglo-Saxon and Danish kings).

Offaly is a county in the province of Leinster in the Republic of Ireland. It is an inland county in the heart of the Irish central lowland. There are extensive peat bogs, and much of the remainder is agricultural land. The principal town and service centre is Tullamore.

People and government. About 95 per cent of the people of Offaly are Roman Catholics. Almost all those of other religions are members of the Church of Ireland.

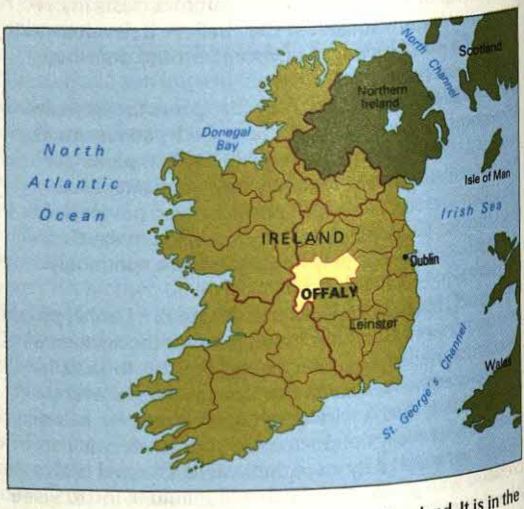
Offaly and Laois form one constituency, which elects five members to *Dáil Éireann* (the lower house of the Republic of Ireland's parliament). Local government is carried out through a county council in Tullamore.

Economy. One-fifth of people in Offaly work in agriculture. Beef cattle production is the leading type of farming. Farmers also raise dairy cattle, sheep, pigs, and poultry, and mixed farming is common. Arable crops include barley, potatoes, sugar beet, turnips, and wheat.

One-fifth of employment is in manufacturing. The main industrial centre is Tullamore. Its industries include building materials, clothing, meat products, medical supplies, and textiles. The main groups of manufacturing in Offaly are clothing and textiles, engineering industries, and food processing.

The various service industries account for two-fifths of employment. The largest number of people work in retail and wholesale distribution. Others work in catering, education, health care, and transport.

Peat production is more important to the economy of Offaly than in any other Irish county. There are peat-burning power stations at Ferbane, Rhode, and Shan-



Offaly is an inland county in the Irish central lowland. It is in the province of Leinster in the Republic of Ireland.

Clonmacnois, in Offaly, was the site of a famous early Irish monastery. The ruins include several churches and, *above,* a round tower and carved cross dating from the 900's.

nonbridge, and a peat briquette factory near Tullamore. New forests cover some bogland and areas of the Slieve Bloom Mountains.

The main railway line from Dublin to the western counties of Galway and Mayo passes through Offaly. The N6 and N7 roads pass along small sections of the northern and southern borders. The N80 from the port of Rosslare to the west and northwest and the N62 from Limerick to Athlone also cross the county.

Facts in brief about Offaly

Population: *1991 census*—58,448.
Area: 1,998 km².
Largest towns: Tullamore, Birr, Edenderry, Clara, Banagher, Ferbane.
Chief products: *Agriculture*—barley, cattle, milk. *Other primary products*—peat, sand and gravel, timber. *Manufacturing*—building materials, clothing, engineering goods, footwear, meat products, plastic goods, textiles, timber products.
Origin of name: From the Irish *Uíbh Fhailí* (descendants of Failghe, who was an Irish prince).

Land. Counties Westmeath and Meath are to the north of Offaly, Kildare to the east, Laois and Tipperary to the south, and Galway and Roscommon to the west. Most of Offaly is flat lowland. The land slopes gently toward the River Shannon, which forms the western boundary of the county. Extensive peat bogs have developed in poorly drained areas. The bogland of the east is part of the large Bog of Allen. Along the Laois border in the south runs part of the Slieve Bloom Mountains.

Rainfall averages 100 centimetres per year. The average temperature is 5° C in January and 15° C in July.

History. Archaeologists have found evidence to show that there were people in Offaly about 9,000 years ago. Much later, it was the ancient kingdom of Ui Failge (now spelled *Uíbh Fhailí*). The greatest of the Irish Celtic monasteries was at Clonmacnois. It was founded in the 500's, overlooking the River Shannon.

After the Anglo-Norman invasion, Offaly remained under Irish control. There was a plan to colonize it under Queen Mary in the 1500's, and it was called *King's County* to honour her husband, King Philip II of Spain. The towns of Tullamore, Birr, and Edenderry developed in the 1600's to 1800's. The largest telescope in the world during the 1800's was in the third Earl of Rosse's famous observatory at Birr Castle.

The population of Offaly declined steadily from the mid-1800's to the 1920's. It grew during the 1970's, but since then emigration from the county has increased.

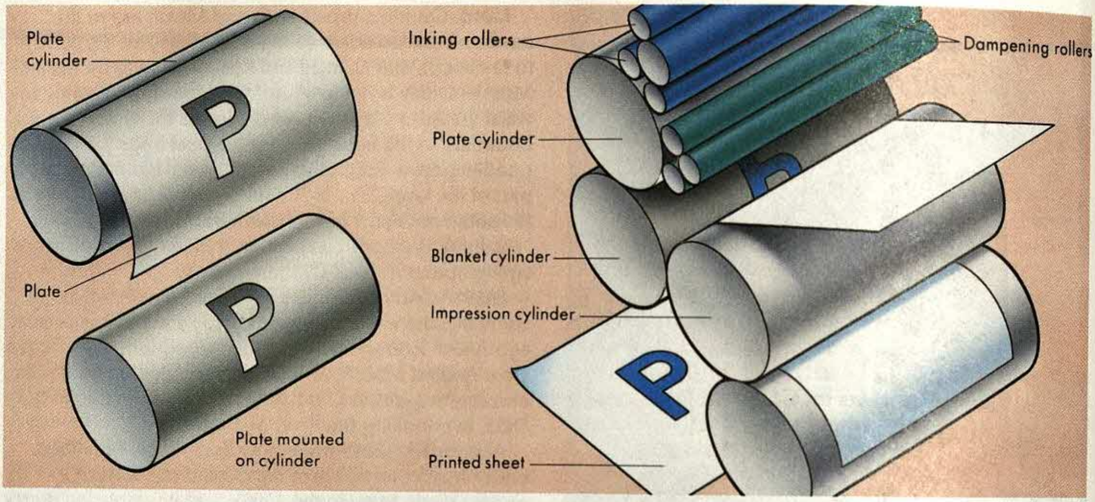
Offa's Dyke is an ancient earthwork between England and Wales. It consists of a ditch and earthen rampart. Offa's Dyke once extended about 225 kilometres, from the mouth of the River Dee in the north to the mouth of the River Wye in the south. Much of it still remains. The best-preserved sections are between Presteign and Montgomery. Offa's Dyke is named after Offa, king of Mercia, who built it between A.D. 784 and 796 as a defence against the Celts of Wales.

Offenbach, Jacques (1819-1880), a French composer, created the French style of operetta. His operettas are humorous, and often satirical. Offenbach frequently quoted themes from some of his other compositions.

Many of Offenbach's operettas are called *opéras bouffes* (comic or light operas). He began composing theatrical works in the 1830's and eventually completed more than 90 works for the stage. His first success was *Orpheus in the Underworld* (1858). His most popular compositions appeared in the 1860's, notably *La Belle Hélène* (1864), *La Vie Parisienne* (1866), *La Grande-Duchesse de Gérolstein* (1867), and *La Périchole* (1868). In 1877, he began his most famous work, the opera *The Tales of Hoffmann,* which was unfinished at his death. See **Operetta.**

Offenbach was born in Cologne, Germany. He moved to Paris in 1833 to study the cello. Offenbach became a conductor at the Théâtre Français in 1850. He founded a theatrical company in 1855, the Bouffes-Parisiens, which staged many of his operettas. He managed the company for many years. He became a French citizen in 1860.

Offset is a printing process in which the printing is done first on the rubber surface of a rotating cylinder. The impression is then transferred to paper by the pressure of other cylinders. The term *offset* describes the transfer, or offsetting, of the ink from a printing plate to the rubber and then to the paper.



Offset lithography printing is not done directly from a printing plate or from type. Instead, the plate cylinder *offsets* (transfers) the inked images onto a rubber blanket cylinder. The rotating blanket cylinder offsets the images onto the paper carried by the impression cylinder.

All ordinary offset printing is done from the metal surfaces of lithographic plates (see **Lithography**). The material to be printed is transferred onto the plates through a special photographic process. The plates are chemically treated so that only the traced design of the print will take up the ink. But the offset process is used for other methods also. Some printing is done from ordinary type and cuts, some from thin plastic relief or letterpress plates, some from gelatine surfaces, and some from *intaglio* plates, which are metal sheets that carry the ink in sunken lines.

Offset lithography is usually done on a press having three cylinders. A lithographic plate is wrapped around the first cylinder. This plate is a sheet of aluminium or zinc about as thick as heavy paper. The plate prints on a second cylinder which is covered by a rubber blanket. The impression on the rubber is then printed on the paper carried by the third cylinder. The third cylinder is equipped with steel fingers, called *grippers,* to hold the paper in position while it is squeezed against the rubber surface. Three-cylinder presses of this type can turn out 10,000 to 12,000 impressions an hour.

These cylinders are almost hidden while the press is in operation. They are covered by a great number of rollers which supply the lithographic plate with ink and water. The cylinders are also concealed by the mechanism for feeding and removing the sheets of paper.

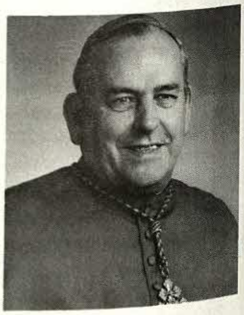
The offset process has several advantages over other types of printing. The elastic rubber used transfers the impression to a rough surface as easily as to a smooth one. This makes it possible to print on rough paper, as well as on tin, celluloid, and other substances. Another advantage of offset is that the rubber on the cylinder fits itself easily to uneven surfaces. This reduces the time workers must spend preparing the presses for printing.

Offset was developed in the early 1900's in the United States as a method of printing tin sheets for making tins and boxes. It has recently been applied to almost every class of printing, from the cheapest to the most expensive. Offset has replaced the older forms of lithography in which the impression was made directly on the paper from stone or metal plates. An offset press can turn out bank notes, letterheads, magazine covers, mail-order catalogues, newspapers, posters, and share certificates. The offset press is used to print most daily newspapers. Offset is combined with *rotogravure,* another printing process, to make coloured illustrations that are clear and delicate. It is also used for facsimile reproduction of old books.

Offset is still being improved and applied to new purposes. The wearing qualities of the lithographic plates are being improved. Offset presses have been designed to print on a *web* (continuous sheet on a spool) of paper. The paper on this *web press* is passed between two rollers covered with rubber blankets, printing on both sides at the same time.

See also **Printing; Photoengraving and photolithography.**

Ó Fiaich, Tomás Cardinal (1923-1990), became Roman Catholic Archbishop of Armagh and Primate of All Ireland in 1977. From 1959 to 1974, he was a professor of modern history at St. Patrick's College, Maynooth. He was president of the college from 1974 to 1977. Tomás Seámus Ó Fiaich was born in Crossmaglen, Northern Ireland, and was educated at colleges in Armagh, Dublin, Maynooth, and Wexford, and at the Catholic university of Louvain, Belgium. Ordained in 1948, he became a lecturer at Maynooth in 1953. Ó Fiaich was made a Cardinal by Pope John Paul II in 1979.


Tomás Ó Fiaich

O'Flaherty, Liam (1896-1984), was an Irish writer of novels and short stories. He wrote many of his works in

Gaelic and translated them into English. Much of O'Flaherty's fiction vividly depicts the barren, rocky landscape and remote villages of the Aran Islands, where he was born and raised. Other works, reflecting his later life, describe grinding poverty in impersonal cities.

O'Flaherty's best-known novel is the harshly realistic *The Informer* (1925). He also wrote *The Black Soul* (1924), *The Assassin* (1928), *Skerrett* (1932), and *Famine* (1937). In these novels, young, poor, and disadvantaged people struggle against overwhelming odds and lose.

O'Flaherty wrote many short stories in economic, lyrical prose. Many of them are collected in *Spring Sowing* (1926) and *The Stories of Liam O'Flaherty* (1956). These stories portray children, peasants, or animals with human emotions, who are helpless in the face of passing time and the destructive force of nature.

Ogaden. See Ethiopia (History; map).

Ogdon, John (1937-1989), an English concert pianist, won international fame while in his early twenties. He performed in many parts of the world, including London, Moscow, Edinburgh, Milan, and Antwerp. He won the Liszt Prize in London in 1961 and the Tchaikovsky Award in Moscow in 1962. Ogdon composed some music, mainly for piano. He was born in Mansfield, Nottinghamshire.

Oglethorpe, James Edward (1696-1785), an Englishman, was the founder of the American colony of Georgia. He was born in London and educated at Oxford University. He joined the British Army at 14. He was elected to Parliament in 1722. There, he became interested in people who had been imprisoned for not paying their debts. Oglethorpe hoped to help them by establishing an American colony for debtors. In 1732, he and a group of associates received a charter from George II for the colony, which was to be established on territory between the Savannah and Altamaha rivers.

Oglethorpe and 114 colonists arrived in America in 1733. He set up his first settlement where the city of Savannah now stands. Few debtors ever came to the new colony. Oglethorpe governed for nine years and drove invading Spaniards back into Florida. He defeated the Spaniards on St. Simons Island, in 1742.

Oglethorpe was so much in debt from his loans to colonists that he had to return to England in 1743. His enemies called him a coward for not capturing St. Augustine, Florida, when he attacked the Spaniards there in 1743. A court-martial dismissed the charges. He and the other trustees returned the Georgia charter to George II in 1752, and Georgia became a royal province.

Ogwr (pop. 130,500) was a local government district in Mid Glamorgan, Wales, administered from the fast-developing industrial town of Bridgend. Towns in the north of the district grew mainly round coal mining, which ended in 1986. Chief industries in the north were engineering and making office equipment. Industries in the south included the making of electronic goods, engines, pharmaceuticals and beauty products, and televisions. The district also included a seaside resort at Porthcawl. From 1996, Ogwr was abolished as an administrative unit after Wales's local government was reorganized into unitary authorities.

O'Hara, John (1905-1970), was an American novelist and short-story writer. He gained fame for his realistic observations on the manners and morals of the American middle class. O'Hara set a number of his novels and stories in the fictional town of Gibbsville, Pennsylvania.

John Henry O'Hara was born in Pottsville, Pennsylvania. He worked as a journalist until he turned to fiction following the success of his first novel, *Appointment in Samarra* (1934). The novel is an ironic picture of upper middle-class life in a Pennsylvania city. O'Hara's other important novels include *Butterfield 8* (1935), *Ten North Frederick* (1955), *From the Terrace* (1958), and *Elizabeth Appleton* (1963). Many of O'Hara's books were made into films, and two of his novels, *Hope of Heaven* (1938) and *The Big Laugh* (1962), are set in Hollywood.

O'Hara received special praise for his short fiction. His collections of stories include *The Doctor's Son* (1935), *Sermons and Soda Water* (1960), *The Cape Cod Lighter* (1962), *The Hat on the Bed* (1963), and *Good Samaritan* (published in 1974, after his death). O'Hara collaborated with composer Richard Rodgers and lyricist Lorenz Hart to turn his story sequence *Pal Joey* (1940) into a musical comedy of the same name.

O'Hara, John Francis Cardinal (1888-1960), archbishop of Philadelphia, U.S.A., became a cardinal of the Roman Catholic Church in 1958. O'Hara was a gifted administrator and pastor who made major contributions to Catholic charities and private education.

O'Hara was born in Ann Arbor, Michigan. He was educated in Uruguay, where his father was American consul, and then at the University of Notre Dame and the Catholic University of America. He was ordained a priest of the Congregation of the Holy Cross in 1916. O'Hara was appointed an instructor of religion at Notre Dame in 1917. At the university he later became prefect of religion and established the College of Commerce. He served as president of Notre Dame from 1934 to 1939. O'Hara was appointed bishop of Buffalo, New York, in 1945 and archbishop of Philadelphia in 1951.

O. Henry. See Henry, O.

Oh, Sadaharu (1940-), became a famous Japanese baseball player. An outstanding batter, he scored 868 home runs in his career in the Japanese leagues. This was a world record, superior to that of the American Henry "Hank" Aaron. Sadaharu Oh was born in Japan, although his parents were of Chinese origin. After graduating from high school in Waseda he became a professional baseball player. His major league career began in 1959 when he joined Yomiuri. He retired in 1980 and was later appointed manager of the Tokyo Giants.

Ohia is a mountain apple tree that grows in Hawaii. The wood is used in furniture and railway sleepers. The ohia belongs to the family Myrtaceae.

O'Higgins, Bernardo (1778-1842), was the chief liberator of Chile and its first leader after independence. He headed the nation from 1817 to 1823.

In 1814, O'Higgins became commander in chief of rebel forces fighting to gain Chilean independence from Spain. In October, the Spaniards defeated the rebels at the Battle of Rancagua, and O'Higgins fled with his army to Argentina. There, he joined forces with the Argentine general José de San Martín. In 1817, the combined armies crossed the Andes Mountains and defeated the Spaniards at Chacabuco, near Santiago. O'Higgins was then named *supreme director* of Chile. O'Higgins and San Martín won a final victory over the Spanish forces in 1818 at the Maipo River.

O'Higgins backed a number of reforms for Chile but met with strong opposition from aristocrats, provincial chiefs, and the Roman Catholic Church. Lack of support for his policies caused him to resign in 1823.

O'Higgins was born in Chillán, Chile. His Irish-born father, Ambrosio O'Higgins, was a colonial official in the service of Spain.

See also **Chile** (History; picture).

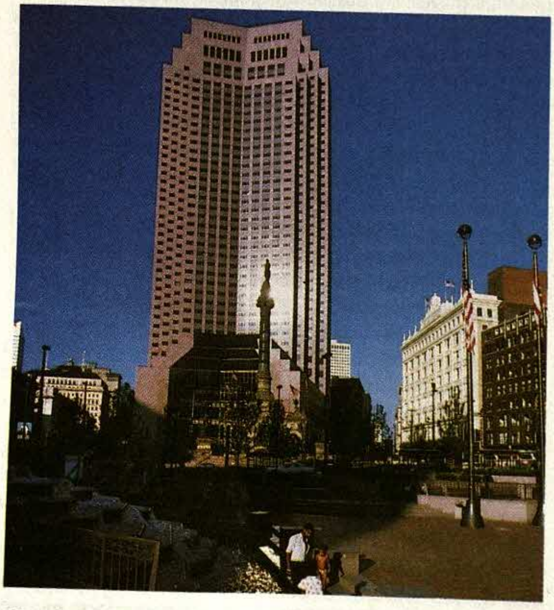
Ohio, a state in the Midwestern region of the United States, is one of the country's leading industrial states. Ohio's abundant water supply, large mineral deposits, and central location helped to make it an important manufacturing area.

Ohio is also an important farming state. Fertile farmlands that make up part of the great Midwestern Corn (Maize) Belt stretch across much of the state. Seven U.S. presidents were born in Ohio (which calls itself "Mother of Presidents"). Columbus is the capital of Ohio.

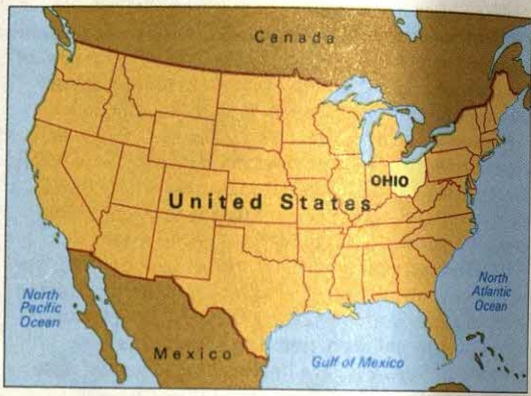
Glaciers formed much of the land of Ohio thousands of years ago. The Ohio River flows along the southern and southeastern borders of the state.

The Great Lakes Plains of northern Ohio form part of a fertile lowland that lies along the Great Lakes. Fruit and vegetables thrive in the region. The Till Plains of western Ohio rank among the most fertile farming areas in the country. In eastern Ohio, the rugged Appalachian Plateau has some of the most beautiful land, with steep hills and valleys, large forests, and waterfalls. The plateau also has Ohio's richest mineral deposits. The Bluegrass Region is a small triangular area in southern Ohio with both hilly and gently rolling land.

Service industries employ about two-thirds of Ohio's workers. Wholesale and retail trade is the state's leading service industry. The ports of Toledo and Cincinnati handle much wholesale trade. Other important activities within the service industries include banking, education, health care, and transportation.



Cleveland city centre includes Public Square, with the 46-storey Standard Oil Building rising in the background.



The state of Ohio lies in the Midwestern region of the United States. It borders on Lake Erie to the north.

Manufacturing is the single most important economic activity in the state. The variety of goods produced is wide, and includes aircraft parts, machine tools, motor vehicles, soap, steel, and plastics.

Coal and natural gas are Ohio's most valuable mineral products. East-central Ohio has the largest coal mines. Natural gas is found mainly in southeastern Ohio.

Field crops provide most of Ohio's farm income. Ohio ranks among the top U.S. producers of maize and soybeans.

Thousands of years ago, North American Indians lived in what is now Ohio. They were the ancestors of peoples called *Mound Builders.* When the first European settlers arrived, several tribes lived in the region.

Disputes between France and Great Britain (now the United Kingdom, or UK) over lands in North America, including the Ohio region, led to the Seven Years' War (1756-1763). Following the war, France surrendered its claim to Ohio.

The United States gained control of the region after the American Revolution (1775-1783). Ohio became a state on March 1, 1803. Trade on the Ohio River, canals, and railways increased the region's prosperity.

Many flood-control projects were established after Ohio suffered devastating floods in 1913. Ohio's international trade began to grow during the 1960's, after eight Ohio cities on Lake Erie became ports of the St. Lawrence Seaway. In the 1980's, lower prices for crops and livestock forced many small farmers out of business.

Facts in brief about Ohio

Population: *1990 census*—10,887,325

Area: 107,044 km².

Climate: *Average January temperature*— −2 °C. *Average July temperature*—23 °C.

Elevation: *Highest*—Campbell Hill in Logan County, 472 m. *Lowest*—along the Ohio River in Hamilton County, 132 m.

Largest cities: Columbus, Cleveland, Cincinnati, Toledo.

Chief products: *Agriculture*—maize, soybeans, milk, beef cattle, pigs, hay. *Manufacturing*—transportation equipment, fabricated metal products, machinery, food products, electrical equipment, chemicals, primary metals. *Mining*—coal, natural gas.

Origin of name: Iroquois Indian word meaning *something great.*

Ohio River is the second most heavily used commercial river in the United States. Only the Mississippi River has more cargo shipped on it. The Ohio flows for 1,579 kilometres through some of the nation's busiest industrial regions and richest farmlands. It serves major coal fields and steel-producing districts.

The Ohio River begins in Pittsburgh, Pennsylvania. It flows mainly southwestward and forms the southern borders of Ohio, Indiana, and Illinois, and the northern boundaries of West Virginia and Kentucky. It empties into the Mississippi at Cairo, Illinois.

Forests of beech, hickory, oak, poplar, and sycamore cover the Ohio River Valley. Animals in these forests include chipmunks, muskrats, raccoons, and foxes.

Ohm is the unit used to measure resistance to the passage of an electric current. All materials resist the flow of electric current. But some materials offer more resistance than others. Materials that offer little resistance are called *conductors.* Materials that offer great resistance are called *insulators.* Electrical resistance (R), measured in ohms, is equal to the electromotive force (E) producing a current, measured in *volts,* divided by the current (I), measured in *amperes*:

$$\text{ohms} = \frac{\text{volts}}{\text{amperes}} \quad \text{or} \quad R = \frac{E}{I}$$

The resistance of a conductor depends on its dimensions and its temperature as well as on the material from which the conductor is made. For example, the resistance of a wire increases as its length increases or as its diameter decreases. Generally, the resistance of a metal increases as its temperature rises.

The international standard for the ohm was adopted in 1893. It was defined as the amount of resistance to a uniform electric current offered by a thread of mercury with a cross-sectional area of one square millimetre and a length of 106.3 centimetres, at a temperature of 0 °C. Engineers have worked out the resistance of standard-sized wires for people who design or work with electric circuits.

Resistance in an electric circuit can be measured with an *ohmmeter.* More accurate measurements can be obtained by using a device called a *Wheatstone bridge* (see **Wheatstone bridge**).

Ohm, Georg Simon (1787-1854), a German physicist, in 1827 discovered the mathematical law of electric currents called Ohm's law (see **Ohm's law**). The *ohm,* a unit of electrical resistance, was named after him. His discovery was neglected until 1833, when he became a professor of physics at Nuremberg. He was appointed a physics professor at the University of Munich in 1849.

Ohm was born in Erlangen, Germany. He graduated from the University of Erlangen.

Ohm's law is a mathematical formula that expresses the relationship between the electromotive force, electric current, and resistance in a circuit. This relationship was discovered by the German physicist Georg Ohm in 1827. When applied to a direct-current circuit, Ohm's law states that the electromotive force (E), measured in volts, equals the current (I) in amperes multiplied by the resistance (R) in ohms:

$$E = IR$$

When the law is used for an alternating-current circuit, resistance is replaced by *impedance* (Z), also in ohms. The flow of alternating current produces a *counter-electromotive force,* which resists the current. The strength of such resistance depends on how rapidly the current alternates. Impedance consists of this resistance, called *reactance,* combined with the circuit's regular resistance to direct current.

Electricians use Ohm's law to determine the efficiency of circuits. For example, they can calculate how the flow of current will be affected by various arrangements of such circuit components as connecting wires, capacitors, and resistors.

Oil. Any greasy substance that does not dissolve in water but can be dissolved in ether is classified as an oil. There are many different kinds of oil. Most are lighter than water and are liquid at room temperature. A few, such as lard and butterfat, are solid at room temperature.

Oils may be obtained from animal, mineral, or vegetable sources. This article chiefly discusses animal and vegetable oils. For more information on mineral oils, which include fuel oils, petrol, and other petroleum products, see **Petroleum.**

Animal and vegetable oils consist chiefly of carbon, hydrogen, and oxygen, and they belong to a family of materials called *lipids.* Animal and vegetable oils are classified as fixed or volatile, depending on whether they evaporate under normal conditions.

Fixed oils, which do not evaporate under ordinary conditions, are also called *fatty oils* or simply *fats.* They include all animal oils and many vegetable oils. Butterfat, lard, and tallow rank as the chief animal oils. Margarine and cooking oil consist mainly of fixed vegetable oils. Other products that are made from fixed oils include candles, linoleum, lubricants, paint, and soap.

Butter makers churn cream to produce butter. People *render* (heat) fatty animal tissues to obtain other kinds of animal oil. Lard is made from fatty tissues of pigs, and tallow from cattle, goats, or sheep. Oils from such sea animals as fish and whales are called *marine oils.*

Most fixed vegetable oils are extracted from such seeds as maize, rape, and sunflower. Processors obtain olive and palm oils from the fruit pulp surrounding the seed. For information on the processing of fixed vegetable oils, see **Vegetable oil.**

Exposure to air causes fixed oils to thicken. The degree of thickening determines whether the oil is classified as (1) drying, (2) semidrying, or (3) nondrying.

Drying oils absorb oxygen from the air to form a tough film. They are widely used to make paints and varnishes. Important drying oils include linseed, perilla, tung or chinawood, soybean, oiticica, hemp, walnut, poppy seed, and sunflower. Linseed oil comes from flax seeds. It is one of the most important drying oils. It is used in making paints and varnishes. Tung oil is a valuable oil used in waterproof varnishes and quick-drying enamels.

Semidrying oils absorb oxygen from the air to become very thick, but not hard. Corn (maize), and sesame oils are of the semidrying type.

Nondrying oils absorb oxygen from the air with little increase in thickness, but they often become *rancid*—that is, they develop unpleasant odours and flavours. Olive, peanut, and grape-seed oils, butterfat, and lard are examples of nondrying types.

Volatile oils, also called *essential oils,* evaporate quickly, especially when heated. Some of these oils come from plants, and others are artificially created. People use volatile oils chiefly for their flavour or odour. The taste of such food flavourings as lemon, mint, and vanilla extracts results from the volatile oils they include. Volatile oils also flavour chewing gum, tobacco, and toothpaste. Most fine perfumes include fragrant oils obtained from roses and other flowers. Manufacturers use such volatile oils as lemon oil to give a scent to soaps and other cleaning products.

Natural volatile oils are extracted from various parts of plants, including bark, flowers, leaves, roots, seeds, and twigs. Methods of obtaining plant oils used for their scent are described in the **Perfume** article. Food processors follow similar procedures in extracting natural volatile oils for flavouring.

Manufacturers use chemical processes to make artificial volatile oils from coal, petroleum, wood, and other substances. Some artificial oils duplicate natural oils. Others differ from any substance found in nature. Such products as artificial oil of rose and artificial vanilla extract cost much less than similar natural substances.

Related articles in ***World Book*** include:

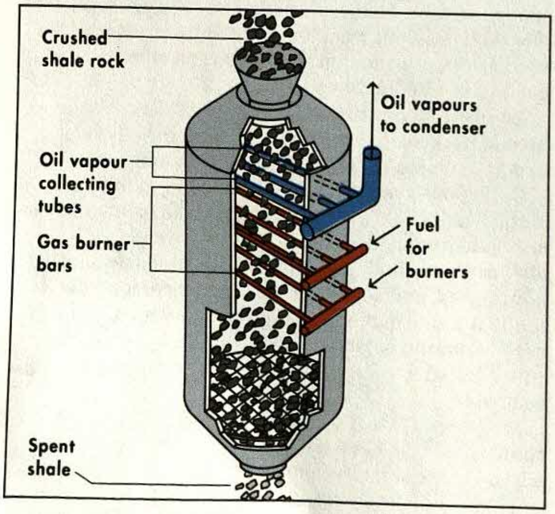
Butter
Castor oil
Copra
Corn oil
Fat
Hydrogenation
Jojoba
Lard
Linseed oil
Lipid
Margarine
Oil shale
Olive oil
Palm oil
Peanut
Peppermint
Petitgrain oil
Petroleum
Sesame
Soybean
Tung oil

Oil gland. See **Acne.**

Oil painting. See **Painting.**

Oil refinery. See **Petroleum.**

Oil shale is a soft, fine-grained sedimentary rock from which oil and natural gas are obtained. Oil shale consists of light brown layers of silt and darker layers of *kerogen,* a waxy organic substance that originated from the remains of blue-green algae and other living matter. Vast deposits of oil shale occur in southern Brazil, northeastern China, Estonia, Sweden, and the United States.



Crude oil is obtained from oil shale by a process called *retorting,* shown above. Crushed shale rock is heated to more than 480 °C by gas burners. The heat releases oil vapours from the rock, and the vapours liquefy in a condenser.

Heating oil shale releases crude oil and natural gas from the kerogen. However, it takes huge quantities of rock to obtain a useful amount of oil. As a result, the oil is expensive to produce. The high cost of production has limited the commercial use of the oil. Only Estonia and China now use oil shale. The only commercial-scale oil shale plant in the United States closed in 1991.

Two methods are used to obtain oil from shale. In the first process, the mined rock is crushed, transported to a processing plant, and heated to temperatures higher than 480 °C. The heat drives oil vapours from the rock, and they condense into liquid oil. The second process is called the *in situ* (in place) method. In this method, miners dig a hole into the bottom of a shale deposit. They then dynamite the deposit, which collapses and shatters. A mixture of air and gas is pumped into the deposit and ignited, heating the rock. Oil vapours separate from the rock and condense into liquid oil again. The oil is then pumped out. See also **Petroleum** (picture).

Oil well. See **Petroleum.**

Oilbird is a cave-dwelling bird found in northern South America. It is related to frogmouths and nightjars but looks more like an owl. Oilbirds have reddish-brown feathers with white dots. Adults measure from 30 to 45 centimetres long. Young oilbirds are unusually plump and contain so much oily fat that they were once slaughtered by people, who used the fat as lamp oil and cooking oil. Oilbirds are also called *guacharos.*

Oilbirds spend most of their time roosting or flying because their feet are poorly developed for walking. They are active at night and eat the fruit of palm and laurel trees. Oilbirds build nests of seeds and bird droppings on top of rocks or ledges deep in caves. An oilbird finds its way in the dark by making sharp clicking sounds. These echo off objects to tell the bird where to fly. Oilbirds also make loud, shrill calls at night.

Scientific classification. The oilbird makes up the oilbird family, Steatornithidae. It is *Steatornis caripensis.*

Oilbirds dwell in caves in tropical regions of northern South America. They have rich brown feathers and large eyes that reflect red in the dark. Oilbirds feed on palm and laurel fruit.

Oilcloth is a heavy, waterproof cloth used to cover tables and walls that must often be washed. It is made of coarse cloth coated with heavy paint. The cloth is stretched on a frame and stiffened with glue. The paint is put on in several coats. Each coat is smoothed with pumice stone after it has dried. Patterns are then printed on, from blocks coated with paint. Oilcloth was first used in China between the 600's and 900's. Any vinyl-coated fabric is sometimes called an oilcloth.

Oireachtas is the national Parliament of the Republic of Ireland. It meets in Dublin at Leinster House, a large mansion built in the 1700's.

The Oireachtas consists of the president, *Dáil Éireann* (House of Representatives), and *Seanad Éireann* (Senate). The *taoiseach* (prime minister) is a member of the Dáil.

The president, who is head of state and the first citizen, is elected by the people for a seven-year term, and is allowed to hold office twice. The president signs laws, calls Parliament into session, and approves ministerial appointments. As guardian of the constitution, the president may refuse to sign laws that appear unconstitutional until the Supreme Court approves them or the people vote for them in a referendum.

The taoiseach is the head of the government. Leading a Cabinet of between 7 and 15 ministers of his own nomination, the taoiseach governs the affairs of the country. Most members of the Cabinet are members of the Dáil, but two may be appointed from the Seanad. The taoiseach is usually the leader of the majority party or of a coalition of parties in the Dáil. The taoiseach and the Cabinet are appointed for a term of not more than five years.

Dáil Éireann makes the laws of the Republic and controls all financial legislation. General elections are held at least once in every five years to elect the 166 members of the Dáil. There are 38 electoral constituencies, each electing 3, 4, or 5 members.

The Dáil elects one of its members to preside over its meetings. This member, called the *ceann comhairle,* acts as an independent chairman.

Seanad Éireann has more limited powers than the Dáil. It can recommend new laws to the Dáil and suggest amendments to laws passed by the Dáil. But the Dáil can accept or reject the Seanad's suggestions. The Seanad can delay a law passed by the Dáil for up to 90 days, but it cannot block it permanently.

The Seanad has 60 members who are appointed for five-year terms. The taoiseach chooses 11 members, and the National University of Ireland and the University of Dublin each elect 3 members. The remaining 43 are selected to represent interests in various fields. They are elected by 990 voters from the Dáil, the Seanad, and from all the various local government authorities.

History. Until 1921, all Ireland was a part of the United Kingdom and the Irish people elected representatives to the UK Parliament in London.

In 1917, followers of the Sinn Fein movement established Dáil Éireann as an independent national council. In a general election in the following year, Sinn Fein candidates won 73 out of 105 Irish seats in the UK Parliament. The newly elected members refused to go to London, insisting that the UK Parliament had no authority to govern Ireland. Half of them were imprisoned or exiled by the British authorities. The remaining members met in Dublin in 1919 and proclaimed the independence of Ireland at a meeting of Dáil Éireann.

In 1921, the United Kingdom agreed to give dominion status to 26 counties of Ireland. Six northern counties remained a part of the United Kingdom. The new dominion was called *Saorstat Éireann* (Irish Free State), and Dáil Éireann was recognized as its official government. In 1937, the Fianna Fáil government abolished the oath of allegiance to the UK Crown and Dáil Éireann approved a new Constitution. The Irish Free State formally became a republic in 1949.

Related articles in ***World Book*** include:

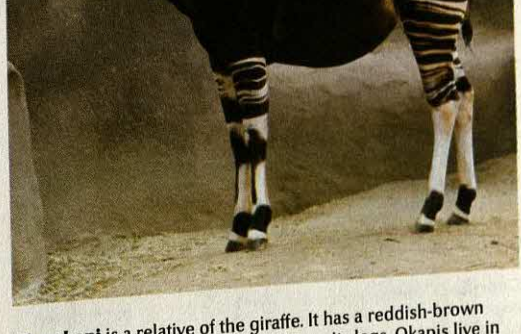
Fianna Fáil
Fine Gael
Ireland, Government of
Labour Party (The Irish Labour Party)
Progressive Democrats

Oistrakh, David (1908-1974), was a leading Ukrainian violinist. He achieved fame for his brilliant technique and rich tone. Such major Russian composers as Sergei Prokofiev and Dimitri Shostakovich wrote chamber music and violin concertos for him. Oistrakh was also a noted conductor and an outstanding teacher of the violin. One of his students was his son, Igor, who became an internationally acclaimed violinist.

Oistrakh was born in Odessa and began studying the violin when he was 5 years old. After graduating from the Odessa Conservatory in 1926, Oistrakh began performing throughout the Soviet Union. In 1934, he was appointed to the faculty of the Moscow Conservatory. Oistrakh attracted international attention in 1937, when he won a violin competition in Brussels, Belgium.

Ojos del Salado is the second highest mountain in the Western Hemisphere. It rises 6,880 metres. Only Aconcagua is higher. Part of the Andes range, it has four distinct peaks on the border between Argentina and Chile. Snow covers Ojos del Salado all year round. For location, see **Argentina** (terrain map).

Okapi is a rare animal that lives in dense forests around the Congo River basin in Africa. It was discovered there by European explorers in 1900. The okapi



The okapi is a relative of the giraffe. It has a reddish-brown body, a white face, and white stripes on its legs. Okapis live in rainforests of the Congo River basin in Africa.

stands about 1.5 metres high at the shoulders. It is related to the giraffe, but its neck is much shorter. The okapi has a dark chestnut body, a white face, and white stripes on its rump and upper legs. The male has a pair of short, hairy horns.

The okapi eats leaves, fruit, and seeds. It travels alone or in pairs. Its chief enemies are leopards and human beings. The okapi has keen hearing.

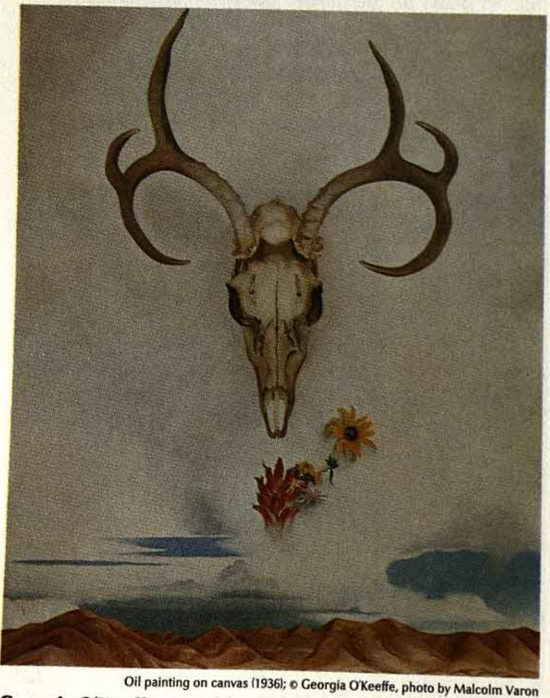
Scientific classification. The okapi belongs to the giraffe family, Giraffidae. It is *Okapia johnstoni.*

See also **Giraffe.**

Okavango, also called Cubango, is a river system in southern Africa. It extends about 1,600 kilometres from its source in the highlands of central Angola to its lower reaches on the edge of the Kalahari Desert in northern Botswana. The Okavango River is fed from two tributaries—the Cubango and the Cuito—that flow southeastward through woodlands and savannah to form a vast wetland region called the Okavango Swamps. These swamps are a source of papyrus reeds.

The Okavango is affected by extreme seasonal variations, from extensive floods to severe drought. The valley is only sparsely populated and it supports a rich and varied wildlife, including water fowls, lions, wildebeest, and hippopotamuses.

O'Keeffe, Georgia (1887-1986), was an American painter who found most of her inspiration in nature. Her flower paintings, which she created throughout her career, are her best-known works. She is also famous for her paintings of animal skulls and desert landscapes. She painted in a highly personalized style, using strong, vibrant colours. Her forms are sensually smoothed and simplified, often into highly abstract designs.



Oil painting on canvas (1936); © Georgia O'Keeffe, photo by Malcolm Varon

Georgia O'Keeffe gained fame for her paintings of the desert region of the American Southwest. *Summer Days, above,* is typical of O'Keeffe's works. Animal bones, flowers, and the desert landscape appear in many of her paintings.

O'Keeffe was born in Sun Prairie, Wisconsin. She studied at several schools, including the Art Institute of Chicago, the Art Students League, and Columbia University. From 1912 to 1918, O'Keeffe taught in Texas, Virginia, and South Carolina. In Texas, she first became interested in the American Southwest. The region's desert landscape greatly influenced her work.

The American photographer Alfred Stieglitz first showed O'Keeffe's paintings in 1916 at "291," his experimental gallery in New York City. For years, he displayed O'Keeffe's work at two other galleries he operated in New York City. Stieglitz and O'Keeffe were married in 1924. In 1929, O'Keeffe began spending much time in New Mexico. Her husband died in 1946 and she settled near Abiquiu in 1949.

Toward the end of her life, O'Keeffe's eyesight began to fail. She then began to work with ceramics, shaping beautifully rounded, sensuous forms and pottery.

See also **Photography** (picture: Expressive portraits).

O'Kelly, Sean Thomas (1882-1966), an Irish patriot and statesman, was president of the Republic of Ireland from 1945 to 1959. O'Kelly was born in Dublin. He was a pioneer of the Sinn Féin movement in the early 1900's and a member of the Gaelic League. He fought in the Easter Rebellion in 1916. He was imprisoned after the rebellion, but was later elected to the first *Dáil* (Parliament), in 1918. Between 1932 and 1945, he was minister for local government, minister for education, and minister of finance.

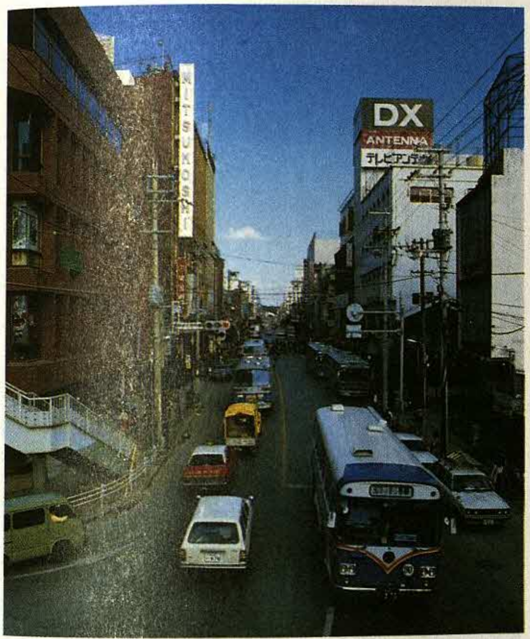
O'Kennedy, Michael (1936-   ), an Irish Fianna Fáil politician, was the Republic of Ireland's minister for labour from 1991 to 1992. He had been minister for agriculture and food from 1987 to 1991, and served on the European Community Commission as commissioner for personnel, consumer affairs, and environment in 1981-1982. Between 1977 and 1980, he had been foreign minister and minister of finance and economic planning.

O'Kennedy was born in Nenagh, County Tipperary, and qualified as a barrister in 1961. He entered *Seanad Éireann* in 1965 and then *Dáil Éireann* in 1969.

Okhotsk, Sea of, is a large arm of the north Pacific Ocean on the eastern boundary of Russia. The sea is about 1,600 kilometres long and 970 kilometres wide, and covers 1,527,600 square kilometres. It is separated from the Bering Sea to the east by the Kamchatka Peninsula (see **Russia** [terrain map]). The Kuril Islands to the south separate the sea from the Pacific Ocean. Ice covers the Sea of Okhotsk from November to April, and heavy fogs and storms occur often. But the sea is used as a trade waterway for the Russian ports of Magadan and Okhotsk. The Amur River and smaller streams empty into the sea.

Okinawa is the largest and most important island of the Ryukyu Islands, a chain of islands in the North Pacific Ocean. It covers 1,434 square kilometres and has 1,048,298 people. Naha, the capital and largest city of the Ryukyus, is on Okinawa. Okinawa is the largest island in the Okinawa *prefecture* (district) of Japan. The prefecture also includes the southern Ryukyu Islands. Almost all of the prefecture's population lives on Okinawa.

Okinawa was under Japanese control before World War II (1939-1945). The United States captured the island



Naha, Okinawa's largest city, is a major commercial centre on the island. The busy International Avenue, *above,* is the main street of the city.

during the war and administered it until 1972, when it was returned to Japanese control.

Okinawa has had military importance for the United States because it is located within easy flying distance of China, Hong Kong, Japan, the Philippines, Taiwan, and Vietnam. The U.S. built air bases and other installations on the island and continues to maintain them there.

Government. Voters elect a governor to head the prefecture of Okinawa. The prefecture's legislature, the *Prefectural Assembly,* consists of 44 members. The prefecture's voters also elect seven representatives to the *Diet* (national parliament) in Tokyo.

People. The people of Okinawa look much like the Japanese, but Okinawans are shorter and have darker skin. Their language belongs to the Japanese language family, and most Okinawans also speak Japanese.

Many Okinawans live in small villages of red tile-roofed houses. Their main food is rice, but they also eat pork. Most village people farm or fish for a living. Many wear traditional Japanese clothing—kimonos or cotton trousers and jackets. Naha and other cities in Okinawa have modern buildings and traffic-choked streets. In the cities, many people wear Western-style clothing.

The University of the Ryukyus, in Naha, is Okinawa's major institution of higher education. About 265,000 students attend the island's primary and secondary schools. About 95 per cent of the people can read and write.

Land and climate. Okinawa is 108 kilometres long and from 3 to 26 kilometres wide. Mountains and jungle cover the northern part of the island. The southern part has low, rocky hills. Most of the people live in the south of the island.

Okinawa has a subtropical climate. The average daily temperature in Naha is 22 °C all year round. Rainfall averages about 210 centimetres yearly, most of it falling in the typhoon season, from April to October.

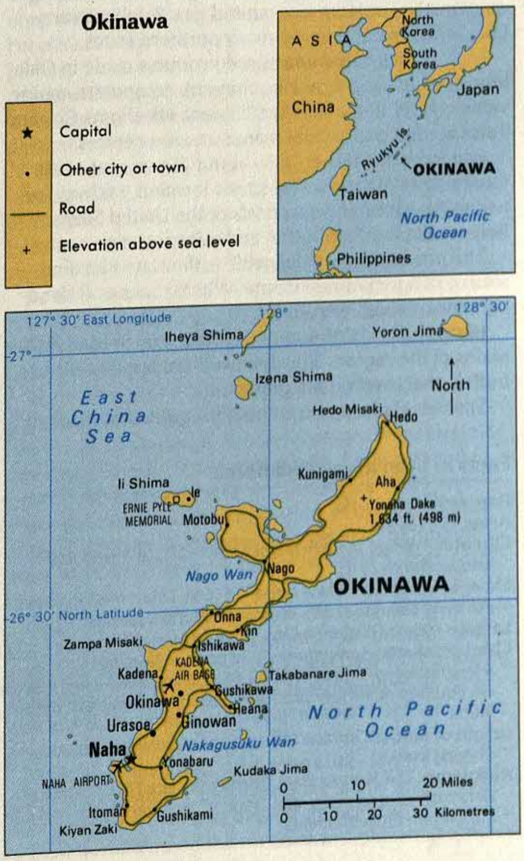
Economy. Before World War II, Okinawa was a poor agricultural island. Today, it has one of the highest *per capita* (per person) incomes in the Far East. Okinawa's economy depends largely on United States military spending. The chief crops include pineapples, rice, sugar cane, and sweet potatoes. Tourism is growing in importance. Most of the tourists come from other parts of Japan.

Okinawan craftworkers make ceramics, lacquerware, and woven and dyed cloth. A pottery kiln in Naha has been operating since the 1600's. Okinawan arts and crafts are prized by art collectors, especially in Japan.

History. Japan and China both claimed Okinawa and the rest of the Ryukus until 1874, when China recognized Japan's rule. For the history of the island before that time, see the article on **Ryukyu Islands.**

One of the bloodiest campaigns of World War II was fought on Okinawa between U.S. and Japanese troops. The Americans landed on the island on April 1, 1945, and conquered it in late June. During the fighting, more than 90 per cent of the island's buildings were destroyed. See **World War II** (Closing in on Japan).

The peace treaty that ended the war gave the United States control of the Ryukyu Islands. In 1950, the United States began to grant some self-rule to the Ryukyuans. It returned the northern Ryukyus to Japan in 1953 but kept


Okinawa

Okinawa and the southern islands. The United States built military bases on Okinawa after the Chinese Communists gained control of China in 1949 and the Korean War broke out in 1950.

Following demands by many Okinawans, the United States returned the island to Japan in 1972. Under an agreement between the United States and Japan, U.S. military bases remain on Okinawa, but nuclear weapons may not be kept on the island without Japan's consent.

Oklahoma is a major fuel and food producing state in the southwestern part of the United States. It also ranks as an important manufacturing state. Oklahoma City is the state capital and largest city.

Land. Oklahoma has a varied landscape. Northeastern Oklahoma is a hilly plateau region with swift streams and steep bluffs. Fertile plains extend west and south of the plateau. The forest-covered Sandstone Hills rise west of the plains. The Ouachita Mountains, the roughest land surface in the state, rise south of the plains. A rolling prairie and forest area covers a portion of southeastern Oklahoma.

A large, gently rolling plain sweeps through the middle of the state. The heavily eroded Arbuckle Mountains and the rough granite peaks of the Wichita Mountains rise south of the plain. The sparkly Gypsum Hills rise west of the plain, where they meet an area of level grassland in the northwestern section of the state. This region includes Oklahoma's Panhandle, a strip of land that juts westward.

Economy. Oklahoma is a leading U.S. state in the production of petroleum and natural gas. Pipelines carry Oklahoma's natural gas to many northern states.

Major types of manufactured products made in Oklahoma include aerospace equipment, computers, motor vehicle parts, and oilfield machinery. Oklahoma City and Tulsa are the state's chief manufacturing centres.

Service industries employ about 75 per cent of the workers in Oklahoma. The state's location, midway between the east and west coasts of the United States, helps make it a distribution and transportation centre.

The production of beef cattle is the state's leading source of agricultural income. Wheat ranks as Oklahoma's most valuable crop.

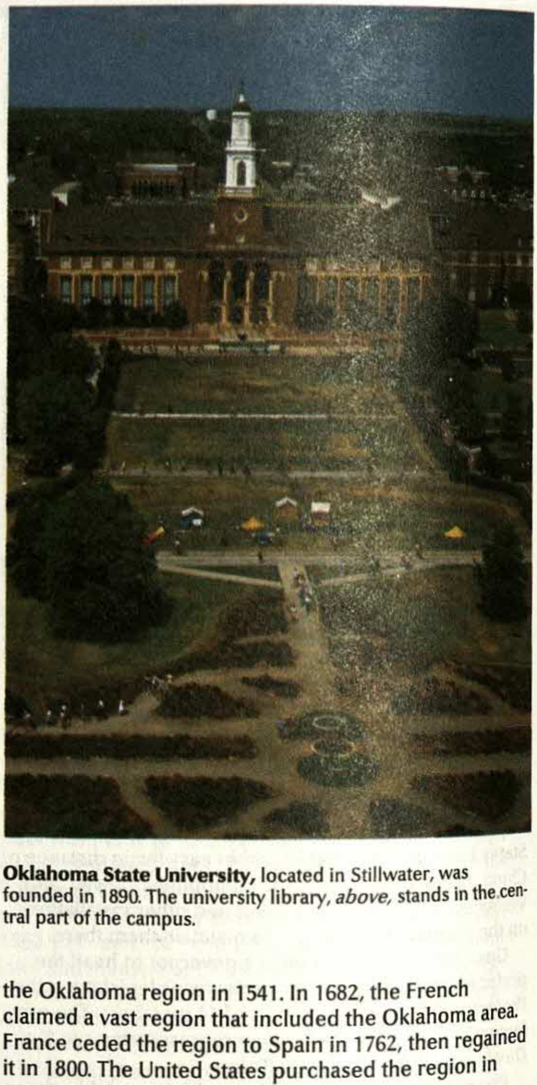
History. Bands of American Indians once roamed the plains of the region. They followed the huge herds of buffalo that lived on the grasslands.

Spanish explorers, searching for gold, first reached the Oklahoma region in 1541. In 1682, the French claimed a vast region that included the Oklahoma area. France ceded the region to Spain in 1762, then regained it in 1800. The United States purchased the region in 1803.

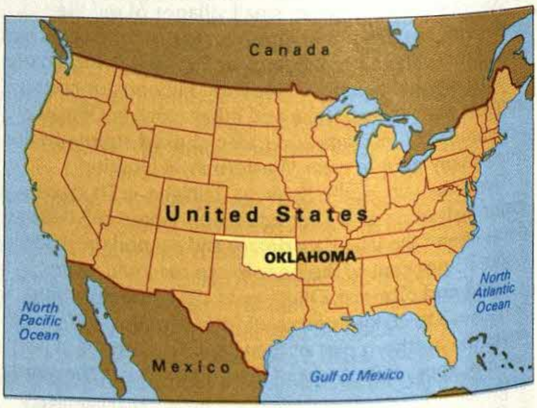
The federal government forced Indian tribes of the southeastern United States to move to the Oklahoma

Facts in brief about Oklahoma

Population: 3,025,495.
Area: 181,186 km².
Climate: *Average January temperature*—3 °C. *Average July temperature*—28 °C.
Elevation: *Highest*—Black Mesa, 1,516 m. *Lowest*—87 m above sea level along the Little River in McCurtain County.
Largest cities: Oklahoma City, Tulsa, Lawton, Norman.
Chief products: *Agriculture*—beef cattle, wheat, hay. *Manufacturing*—transportation equipment, machinery, electrical equipment, rubber products. *Mining*—natural gas, petroleum.
Origin of name: Choctaw Indian words—*okla* (people) and *homma* (red).
Nickname: The *Sooner State.* (During the late 1800's, some settlers rushed in to claim land "sooner" than the region was officially open for settlement.)



Oklahoma State University, located in Stillwater, was founded in 1890. The university library, *above,* stands in the central part of the campus.



Oklahoma has a varied landscape of hills, plateaus, mountains, and rolling prairies and forests.

area. But by the late 1800's, the government had opened much of the Indians' land to white settlement.

On Nov. 16, 1907, Oklahoma became the 46th state of the U.S.A. The state suffered many hardships during the Great Depression of the 1930's, including a severe drought. Small farmers went out of business, and many people left the state.

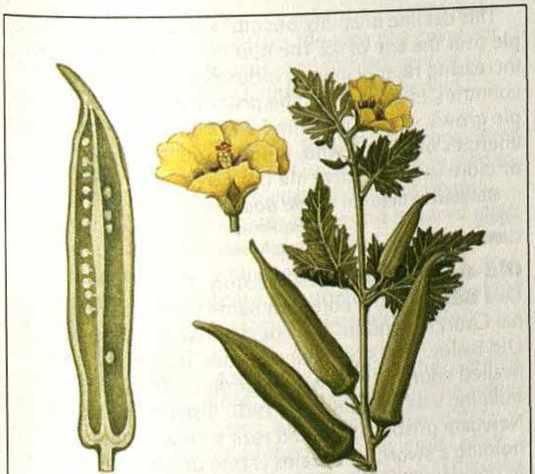
During World War II (1939-1945), Oklahoma's major products—food and fuels—again came into great demand. After the war, the state's economy began to shift from an agricultural to an industrial base. During the 1980's, deep declines in agricultural prices, and in oil and gas prices, hurt Oklahoma's economy.

See also **Indian Territory**.

Oklahoma City (pop. 444,719; met. area pop. 958,839) is the capital and largest city of Oklahoma. The city ranks as one of the chief centres of oil production in the United States. It is a commercial and manufacturing centre of Oklahoma and a distribution point for a large farming area.

Oklahoma City lies on the North Canadian River, near the geographic centre of the state. It produces car assemblies, construction equipment, electronic equipment, food products, and petroleum products.

On April 19, 1995, Oklahoma City was the scene of one of the worst peacetime bombing outrages in U.S. history. A bomb destroyed the Alfred P. Murrah Federal Building, a multistorey building housing several U.S. federal government departments and agencies. Right-wing extremists were blamed for the blast, which killed 168 people.



Okra is a tall plant grown for its sticky green pods, which are used in cooking. The plant bears greenish-yellow flowers.

Okra, also known as "lady's fingers", is a plant cultivated for its immature pods, which are used in stews, to thicken and flavour soup, and as a vegetable. The plant is an annual. It grows 0.5 to 2.5 metres high. It bears rounded, fine-lobed leaves, and greenish-yellow flowers. The pods on the plant are from 10 to 15 centimetres long, but sometimes exceed 30 centimetres when fully grown. Okra pods are cooked when young and tender.

Okra is a kind of hibiscus, and it is closely related to cotton. It is a native of Africa.

Scientific classification. Okra belongs to the mallow family, Malvaceae. It is *Hibiscus esculentus.*

Olav I. See **Norway** (The Viking period).

Olav II. See **Norway** (The Viking period).

Olav V (1903-1991) became king of Norway in 1957 when his father, King Haakon VII, died. Olav was born in England, and he went to Norway when he was 2 years old. He attended the Norwegian War College and Oxford University. He frequently served as regent during his father's illnesses. Olav was chief of Norwegian defence forces during World War II (1939-1945). His wife, Princess Märtha of Sweden, died in 1954.

Old age cannot be defined exactly because it does not have the same meaning in all societies. In many industrial societies, people often consider that old age begins when a person reaches the ages of 60 or 65. This is because in those countries these are the ages at which women and men can receive pensions paid by the state on their retirement from full-time employment. In the United Kingdom and the Republic of Ireland, for example, men begin receiving state pensions at the age of 65. Women get pensions at 60. When people retire from work, they may also be eligible to receive extra pensions from schemes run by employers, or from a private pension fund to which they have made payments while working. See **Pension.** People in the 65-and-over age groups are often called *senior citizens* or *pensioners.*

However, in some societies people may be considered old because they have grandchildren or grey hair. People's *life expectancy* (the average age to which people may be expected to live) varies from country to country. One hundred years ago, in Western countries, a person was considered old at 55. Today, the life expectancy of a person in many industrial countries is over 70. This increase has been brought about by improvements in diet, hygiene, medicine, and public health and by medical discoveries, which continue to be made. In poor countries, with less advanced medical and welfare services, life expectancy is usually lower.

In many industrial nations, the number of old people in the community is growing. In Australia, only about 4 per cent of the population was over 65 in 1901. By the late 1980's, the proportion was 11 per cent.

In the late 1980's, in Ireland, about 11 per cent of the population were aged 60 to 74, and about 4 per cent were over 75. In the UK, the percentages were about 14 per cent in the 60-74 age group, and 7 per cent aged over 75. However, in India and Indonesia, there are fewer old people in the population. In the late 1980's, about 6 per cent of Indians and 5 per cent of Indonesians were aged 60 to 74. Only 1 per cent in both countries were over 75.

In Europe and North America, the percentage of people who are 65 and older has more than doubled since 1900. The number of individuals reaching 65 is growing chiefly because more children reach adulthood. New medical discoveries continually enable more and more people to live longer.

Women in the West, on average, live longer than men. One reason for this difference is that fewer women than men die from heart disease and cancer.

For information on the medical and physical aspects of old age, see the *World Book* articles on Aging and Geriatrics.

Attitudes toward old age

Many people look forward to old age as a time of increased leisure and reduced responsibility. Old people with a high retirement income may look forward to pleasurable activities. They are eager to travel or to pursue other interests and activities after their children are grown and they themselves have retired. For those old people who live on small pensions, life may not offer such exciting possibilities. Their standard of living may fall, and they may dread growing old.

Many people expect old age to be worse than it turns out to be. The majority of old people consider themselves active, alert, and open-minded. But they believe that most other elderly people do not have those characteristics.

In many countries, the long life and experience of the elderly give them a respected position in society. In modern industrial nations, however, many people do not regard the elderly as wiser or more knowledgeable. In all societies, old people are more respected if they control important resources, such as money or land. In industrial societies, where income from work is a major resource, retired people with lower incomes may lose status as their savings and earnings diminish.

People of all ages agree that the worst problems of old age are finances, health, loneliness, and personal safety. But old people themselves report that these problems are less common than the general public thinks they are.

In the West, a person's status in society often depends on his or her job. So when people retire, they often lose a certain amount of status. This is because retired people usually have lower incomes than working people. They may also feel unwanted.

This is less of a problem in the East. People in Asian countries, for example, tend to have closer family structures than people in the West. In India, Japan, and other Asian countries, elderly people live in the homes of their adult family. An Asian extended family may contain several generations living in one home. The old people are respected as leaders of the community. However, in some other Asian countries, the old are seen as a burden on scarce resources, and little effort is made to care for them.

Ways of life of the elderly

Although the elderly spend much of their time doing the same things as younger people, they do have special needs, and often follow different ways of life.

On retirement, most people in industrial countries have a smaller income. They must therefore adjust to a changed way of life. They may have to give up luxuries such as holidays, and may spend less on clothes and entertainment outside the home.

Many old people welcome help and advice in facing retirement. They may welcome advice on how to take up new leisure and hobby interests. Many old people worry about their reduced income.

Increasing dependence on the state is a feature of growing old in many countries. In Australia, for example, more than 75 per cent of the elderly population are dependent on income from government pensions.

Social isolation of the old can be a problem, especially in countries where children and grandchildren often live a long way from elderly relatives. In particular, many married women face widowhood in old age. Loneliness can be a serious problem for the elderly.

Physical and intellectual disabilities trouble the old more than the young. People over the age of 75 need more help and support from medical and welfare services. The elderly require a doctor's services more often as they age, and they may also need such services as meals on wheels and home nursing, or eventually permanent residential care for those who are too ill, frail, or mentally confused, to look after themselves. Whereas in the East, care of the old is still regarded as a family responsibility, in many Western countries it is seen as at least partly a government responsibility.

Many old people continue to enjoy a vigorous and full life into their 80's and beyond. They often take part in social, educational, sporting, and cultural activities with other people in their age-group. Senior citizens in some countries may benefit from cheap or free travel on public transport, and from reduced prices on tickets for theatres, concerts, and similar events.

The process of aging takes place at different rates. This explains why some people remain physically active and intellectually creative into advanced old age. The less fortunate may suffer from medical complaints particularly associated with aging, such as arthritis, heart diseases, diabetes, and high blood pressure. Hearing, eyesight and digestion as well as memory may also be affected.

This decline in ability becomes more marked in people over the age of 85. The number of people over 85 is increasing rapidly in both industrial and developing countries. In general, as the proportion of retired people grows, society must find ways to use the talents and energies of people who, though "old", may well have 25 or more years of active life before them.

Related articles in ***World Book*** include:

Aging
Geriatrics
Life expectancy
Nursing home
Senility

Old-age pension. See Pension.

Old Bailey is the common name for the Central Criminal Court in London. The court house is in a street called Old Bailey. This street once formed part of the *bailey* (walled courtyard) between Ludgate and Newgate. The building was completed in 1907. It stands on the site of Newgate prison. Its domed roof with a statue of justice holding a sword and scales is one of the famous sights in the city of London.

The Old Bailey has the jurisdiction to try any offences committed within the City of London and Greater London. It also has the wider power to try offences committed in England and Wales and on the high seas. The judges of the Old Bailey are the high court judges, the Recorder of London, and the Common Serjeant.

Old Catholic churches are a group of Christian churches that split away from the Roman Catholic Church. Most of them were formed by Catholics who opposed the dogma of *papal infallibility* proclaimed at the first Vatican Council in 1870. This dogma states that the pope is free from error when he speaks as head of the church on matters of faith and morals.

The Catholics who withdrew from the Roman Catholic Church at that time established an independent church. Most of these Catholics lived in Germany, the Netherlands, Switzerland, and the Austro-Hungarian Empire. In 1889, the independent church formed a loose relationship with other dissenting Catholic churches under the terms of an agreement called the Union of Utrecht. Some of these dissenting churches had been established as early as 1724.

Old Catholic churches generally follow Roman Catholic doctrine, though the clergy may marry. The churches encourage Bible study.

Old English. See **English language** (Old English); **English literature** (Old English literature).

Old English sheepdog is best known for its long hair, "bobbed" tail, and odd, shuffling walk. Its hair hangs down over its eyes. Its long coat is a grizzly grey or blue, often with white markings, or predominantly white, with markings. The dog stands about 55 centimetres high, and weighs from 23 to 29 kilograms. See also Dog (picture: Herding dogs); **Sheepdog.**

Old Sarum is a large, cone-shaped hill about 90 metres high and surrounded with earthworks. It lies near Salisbury, in Wiltshire, England. Old Sarum was fortified in turn by the ancient Britons, the Romans, and the Saxons. It was later the site of a Norman castle, and Bishop Herman founded a cathedral there in about 1072.

Old Spanish Trail. See **Santa Fe Trail.**

Old Testament is the first part of the Bible. Together with the New Testament, it forms the Scriptures that are sacred to Christians. Jews accept only the Old Testament, which they call the *Hebrew Bible,* as sacred. The word *testament* here means *covenant,* or agreement. The Old Testament emphasizes the idea of a covenant between God and His people, and forms a record of their history to show how faithfully they observed this covenant.

For over two thousand years, people have considered the Old Testament the word of God, and have turned to it for guidance on life's problems. Millions of people have found in it great religious truths and inspired ethical teachings. As a cultural treasure, the Old Testament is one of the most important sources we have for knowledge of the past. In addition, the poetry and prose of the Old Testament include some of the greatest literary masterpieces of the world.

Contents. According to Jewish tradition, there are 24 books in the Hebrew Bible. Protestants accept the same books as the Old Testament, but arrange them differently. They divide several of them, making a total of 39. The Roman Catholic Old Testament consists of 46 books. It includes seven books that Protestants consider part of the Apocrypha. For a list of Old Testament books, see the *table* with the *World Book* article on the **Bible.**

Jews divide the Old Testament into three main sections called the Law, the Prophets, and the Writings.

The Law, or *Torah,* consists of the books of Genesis, Exodus, Leviticus, Numbers, and Deuteronomy. It is also called the *Pentateuch* or *Five Books* of Moses (see **Pentateuch**). The Hebrew word *Torah* is usually translated as *the Law,* but a more accurate translation would be *teaching* or *guidance.* The Law describes God's creation of the world and humanity. It then gives an account of the lives of Abraham, Isaac, and Jacob, the *patriarchs* (fathers) of the Hebrew nation (see **Patriarch**). Other narratives include the story of Joseph, the history of the Israelites in Egypt, and the Exodus from Egypt under the leadership of Moses. The books of Numbers and Deuteronomy describe the experiences of the people in the desert and the death of Moses before they entered the Promised Land of Canaan. Laws dealing with all phases of life are woven into the narratives. They include religious and moral teachings, ritual practices, health, and civil and criminal laws.

The Prophets are divided into two parts, the Former Prophets and the Latter Prophets. The books of Joshua, Judges, Samuel, and Kings make up the Former Prophets. These books trace the history of the Hebrew nation from the time it entered Canaan until the destruction of the kingdoms of Israel and Judah in 587 or 586 B.C. The books describe the lives and activities of many prophets, such as Elijah. They also interpret the history of the Hebrews from the point of view of the prophets. The prophets taught that obedience or disobedience to God's laws shapes humanity's destiny. The Latter Prophets consist of four books—Isaiah, Jeremiah, Ezekiel, and the Twelve (teachings of 12 other prophets).

The Writings, or *Hagiographa,* consist of books written by teachers, poets, and great thinkers. The Writings contain the books of Psalms, Proverbs, and Job, and the five *Megillot,* or Scrolls: Song of Solomon, Ruth, Lamentations, Ecclesiastes, and Esther. The Book of Daniel and the later historical works of Ezra, Nehemiah, and Chronicles complete this section of the Old Testament.

Christian and Jewish groups differ in the position of importance they assign to the books of the Apocrypha. Many of these books resemble those of the Old Testament in form but were written later. See **Bible.**

Date. The Old Testament was written over a long period of time. The process was complicated because much of the material was recited or chanted out loud long before it was written down. Scholars disagree about how and when the books were actually written. But most scholars agree that parts of the Old Testament are very ancient. One of the earliest poems is the "War Song of Deborah" (Judges 5), composed about 1100 B.C.

Many parts of the historical and prophetic books were written during the time of the two kingdoms of Israel and Judah. Some of the most important prophets and poets lived during the Babylonian Exile, from 587 or 586 B.C. to 538 B.C. Many traditions, laws, and historical records that had accumulated were collected and put in order at that time.

Other books were written after the exile, when many Jews were allowed to return to Palestine. Chronicles, Psalms, Ecclesiastes, and Song of Solomon were written during that time, and completed by about 200 B.C. Esther and Daniel appeared later, during the 100's B.C.

Translations. The entire Old Testament was written in Hebrew, except for some chapters in the books of Daniel and Ezra and a few words in Genesis and Jeremiah. These are in Aramaic, a language much like Hebrew (see **Aramaic language**).

The Old Testament was probably the first work ever translated. The first translations were oral versions from Hebrew into Aramaic called *Targums.* During the mid-200's B.C., Jewish scholars working in Alexandria, Egypt, translated the Law into Greek. This translation is called the *Septuagint.* Translations of other Old Testament books followed. For a historical discussion of translations of the Old Testament, see **Bible** (Translations of the Bible).

See also **Bible** and its list of *Related articles.*

Old Vic is a theatre near Waterloo Station in London. The Old Vic was for many years a centre of Shakespearean drama. In 1963, it became the temporary home of the National Theatre. The theatre opened in 1818 as the *Coburg,* but it changed its name after a visit by Queen Victoria while she was still a princess.

Old World is a general term applied to the Eastern Hemisphere. The Western Hemisphere is called the *New World.* The Old World includes the continents of Europe, Asia, Africa, and Australia. But the term *Old World* is often used to refer just to Europe or to European civilization. The terms Old World and New World are used in botany and zoology. For example, zoologists divide monkeys into two groups, Old World monkeys and New World monkeys. See also **Hemisphere.**

Oldenburg, Claes (1929-), is an American sculptor who became a leader of the pop art movement during the early 1960's. He is known for his exaggerated, oversized sculptures that represent such familiar objects as ice cream cones, electric plugs, lipstick tubes, and Mickey Mouse. Using these objects as the single subjects of his works, Oldenburg has created two main types of sculpture. One type consists of sculptures made of soft material, thus contradicting the hardness of the actual objects. This material is often in a bright colour related to its subject. An example, *Giant Soft Fan, Ghost Version,* made of canvas, wood, and foam rubber, is 3 metres high. The second type is made up of huge steel monuments of common objects designed to be placed in landscapes or among buildings. See **Pop art.**

Oldenburg was born in Stockholm, Sweden, and became a U.S. citizen in 1953. He is also noted for excellent preparatory drawings for his sculptures and for prints of his sculpture subjects.

Oldham (pop. 211,400) is a town in Greater Manchester, England. It is about 8 kilometres northeast of central Manchester. The town's many industries include aerospace and electronics manufacture. Textiles, once the town's main industry, is still important.

Oldham lies to the west of the Pennine Hills. See **Manchester, Greater.**

Olds, Ransom Eli (1864-1950), was an American pioneer inventor and manufacturer of motorcars. Two cars, the Oldsmobile and the Reo (from his initials), were named after him. In 1886, he began experimenting with steam-powered carriages in his father's machine shop in Lansing, Michigan. He later made a four-wheeled steam car which he sold to a firm in India in 1893. It was the first U.S. car sold abroad.

Olds built his first petrol-operated car in 1896. In 1899, he helped found the Olds Motor Works in Detroit, Michigan. A lightweight, one-cylinder, low-cost model was in volume production by 1901. Many thousands of these cars were sold by 1906. In 1904, Olds left the Olds Motor Works and set up a firm to make Reo cars and trucks. He was president of the Reo Motor Car Company from 1904 to 1924 and later chairman of the board.

Enamelled burlap and plaster (1962); The Museum of Modern Art, New York City

Oldenburg's *Two Cheeseburgers with Everything* illustrates his use of soft materials to depict familiar objects.

Olds was born in Geneva, Ohio. Many people consider him the founder of the motorcar industry. He built the first car factory, and was the first manufacturer to mass-produce cars. Furthermore, the success of the Oldsmobile attracted other manufacturers into the industry and helped make the car popular.

See also **Car** (The steam car; The United States car industry).

Olduvai Gorge. See **Tanzania** (History); **Leakey family.**

Oleander is an ornamental flowering shrub which is valued as a house plant. The oleander sometimes grows 4.5 metres tall. It bears leathery lance-shaped leaves and showy roselike flowers. The two most common varieties have red and white blossoms. The oleander is native to the warm parts of Asia and to the Mediterranean region. Gardeners plant it outdoors in warm climates and in pots and tubs in temperate regions. All parts of the oleander are poisonous.

Scientific classification. The oleander belongs to the dogbane family, Apocynaceae. It is *Nerium oleander.*

O'Leary, Michael (1936-), an Irish politician, led the Labour Party of Ireland from June 1981 to October

The oleander is an ornamental flowering shrub. It produces leathery, lance-shaped leaves and colourful roselike blossoms.

1982. He was *tánaiste* (deputy prime minister) in the Labour-Fine Gael coalition government of 1981-1982. O'Leary was born in Dublin. He was elected to *Dáil Éireann* in 1965. He was minister of labour in the government of 1973-1977.

Oleic acid. See **Fat** (Structure).

Olein. See **Lard.**

Oleoresin. See **Resin.**

Olericulture. See **Horticulture.**

Olfactory bulb. See **Nose; Smell.**

Olgas are a group of large, rounded rock outcrops 32 kilometres west of Ayers Rock in the Northern Territory of Australia. They cover 25 square kilometres, and are surrounded by a sand dune plain. Mount Olga, the highest point, rises 1,025 metres above sea level.

Olibanum. See **Frankincense.**

Oligarchy is any type of government in which power is held by relatively few people. An oligarchy may take different forms. A republic may be an oligarchy if only a few people have the right to vote (see **Republic**). An aristocracy, in which rulers come from the "best" members of the community, is also a form of oligarchy (see **Aristocracy**). In most oligarchies, the ruling group has power through wealth or military authority.

The term *oligarchy* traditionally has been seen as the rule of a selfish few over a whole community. However, some political scientists apply the term to all forms of political and social organization, including states, political parties, churches, and corporations.

Oligarchies have existed throughout history. Most ancient Greek city-states were classic examples. In modern times, a number of military dictatorships in Africa, Asia, and Latin America have operated like oligarchies.

Oligocene Epoch. See **Earth** (table: Outline of the earth's history).

Oligopoly. See **Monopoly and competition.**

Olive is the fruit of a tree that grows in subtropical regions. Olives are cultivated chiefly for their oil, which is used in cooking. The fruit is also eaten whole after processing. People have grown olives since prehistoric times. Experts think the fruit first grew in the eastern Mediterranean basin. Although, today, the olive tree is found in many parts of the world, the leading olive growing countries are still in the Mediterranean region. Spain and Italy produce about half the world's olives.

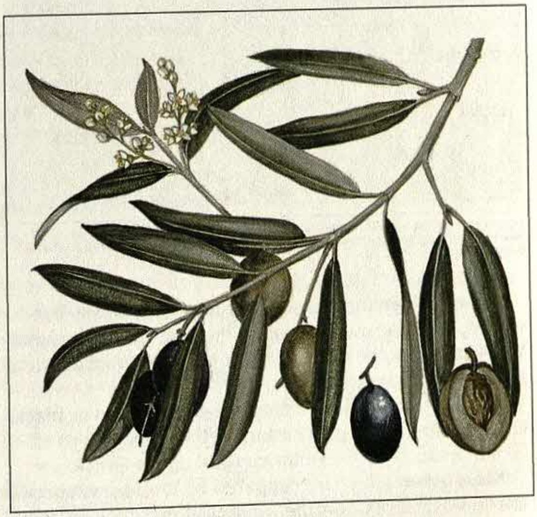
Appearance of the fruit and tree. The fruit may be oval or oblong. As it matures, it turns from green to yellow to red to purple-black. It has a smooth skin, and its flesh surrounds a hard pit. Both the flesh and the seed in the pit contain oil. Fresh olives contain *oleuropein,* a bitter substance that makes them unpleasant to eat straight away. It is removed during processing.

The olive tree's bark and leaves are a soft grey-green, and its trunk becomes gnarled as it ages. Olive trees live longer than most other fruit trees. Some of the olive trees planted by the Roman emperor Hadrian near Rome in A.D. 140 are still alive.

A mature olive tree may have as many as 500,000 small flowers. Most of the flowers are imperfect, and fruit cannot grow from them. They give off pollen, which is usually carried from flower to flower by the wind. Most varieties of olive trees bear a large crop one season and a small crop the next.

Cultivation. Parts cut off from an olive tree may take root and grow into new trees. The trees will grow in many types of soil but need good drainage. To produce large fruit, the grower must irrigate and prune the trees, and thin the fruit. Fertilizers that add nitrogen to the soil can increase yields. The olive tree will grow where the climate is hot and dry. But for bearing good fruit, the tree needs a moderate supply of water. The fruit is injured if the temperature falls below −3 °C. The tree itself is not seriously injured until the temperature falls to −9 °C. The fruit needs much heat to have a good quality when mature. For a good crop, the air must be dry when the flowers blossom, and also when the fruit begins to grow.

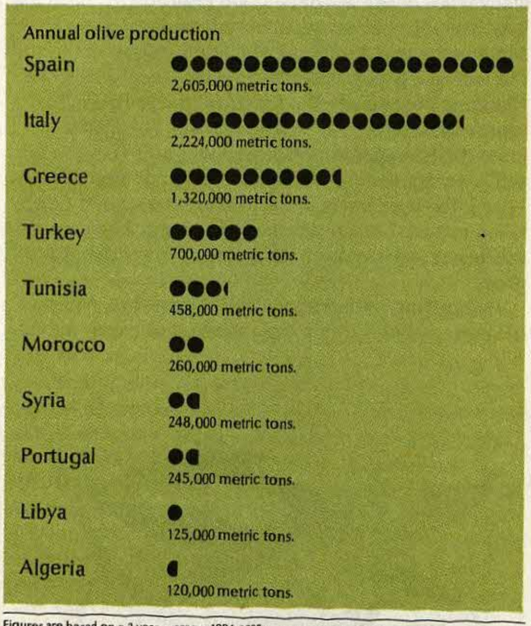
Harvesting and preparation for market. Most olive-producing nations grow the fruit primarily for its oil.



Olives are a small, oval or oblong fruit. They are grown chiefly for their oil, which can make up about half the flesh of the fruit.

An olive tree has a gnarled trunk and grows many small flowers. The tree thrives in warm regions.

Leading olive-growing countries



Figures are based on a 2-year average, 1984-1985.
Source: *FAO Production Yearbook, 1985,* Food and Agriculture Organization of the United Nations.

Olives grown for their oil may be mechanically harvested. Olives grown for eating must be picked by hand. Workers place the fruit in small boxes and transport it to the processing plant.

Olives processed for eating are either green or black. One of three major processing methods may be used: (1) the Spanish, (2) the American and (3) the Greek.

Most green olives are prepared by the Spanish process. In this process, unripe, yellowish-green olives are placed in lye solution. The lye removes most of the bitter taste of the oleuropein. The olives are washed and then fermented in brine. The fermented olives may be pitted and stuffed with such fillings as almonds and pimentos. They are then packed in fresh brine and pasteurized.

The American process ripens immature, yellow-to-red olives artificially. The fruit is alternately submerged in lye and exposed to the air until no bitterness remains and the olives have turned brown to black. The fruit is then washed and pickled, canned, and sterilized.

In the Greek process, ripe, purple-black olives undergo a slow fermentation in brine. During fermentation, the fruit's bitterness decreases until the brine masks it. This process traditionally does not use lye.

Scientific classification. Olives belong to the olive family, Oleaceae. They are *Olea europaea.*

See also **Forsythia; Fringe tree; Olive oil; Spain** (picture: Olive orchards).

Olive oil is a fragrant, edible oil made from olives. It is used primarily as a salad dressing and as a cooking oil. It ranges in taste from sweet to bland and consists almost entirely of unsaturated fat (see **Fat**). Most olive oil has a light greenish-yellow colour.

Olive oil is widely used in countries along the Mediterranean Sea. Italy is the world's leading producer of olive oil. Spain and Greece also make and use large quantities.

Olive oil is made by crushing and pressing ripe olives. Whole olive fruit consists of 20 to 30 per cent oil, and the fruit pulp is 60 to 80 per cent oil. Producers use hydraulic presses to squeeze the oil out of the fruit under low pressure. This technique, called *cold-pressing,* generates little heat, and so the oil retains its flavour, colour, and nutritional value. Thus, olive oil, unlike most other vegetable oils, needs no further processing before being packaged. It also can be stored for months without refrigeration or danger of spoilage.

Cold-pressing commonly is carried out in several stages, with only some of the oil being extracted at each stage. The process remains basically the same throughout, but the quality of the oil declines with each pressing. In most cases, olives are cold-pressed at 4 °C. Water is added during pressing to make the oil flow better. The oil is later separated from the water in a spinning machine called a *centrifuge,* or it is skimmed off the water's surface after settling there.

The first pressing gives the highest quality oil, usually called *virgin olive oil.* Virgin olive oil is more expensive than other vegetable oils, so it often is considered a gourmet item. The lower-quality oils from later pressings are often blended in small amounts with other oils. Olive oil that comes from the final pressing is inedible. This oil, called *olive residue* or *olive foots,* is used in cosmetics, detergents, soap, medicines, and textiles.

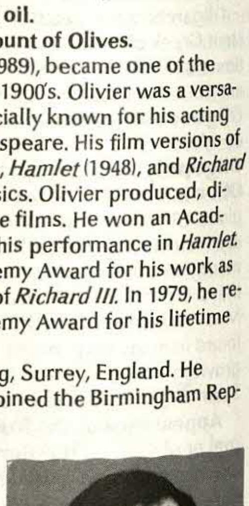
See also **Olive; Vegetable oil.**

Olives, Mount of. See **Mount of Olives.**

Olivier, Laurence (1907-1989), became one of the leading English actors of the 1900's. Olivier was a versatile performer and was especially known for his acting in the plays of William Shakespeare. His film versions of Shakespeare's *Henry V* (1944), *Hamlet* (1948), and *Richard III* (1955) are considered classics. Olivier produced, directed, and starred in all three films. He won an Academy Award as best actor for his performance in *Hamlet.* He was given a special Academy Award for his work as producer, director, and star of *Richard III.* In 1979, he received another special Academy Award for his lifetime achievement in the cinema.

Olivier was born in Dorking, Surrey, England. He made his debut in 1924 and joined the Birmingham Repertory Company in 1926. His first screen appearance was in 1930. Olivier gained international fame for his romantic roles in *Wuthering Heights* (1939) and *Rebecca* (1940). From 1963 until 1973, he served as the first director of the National Theatre of the United Kingdom.

Olivier was knighted in 1947. In 1970, he became Lord Olivier of Brighton, the first actor in English history to be named a baron. His autobiography, *Confessions of an Actor,* was published in 1982. *On Acting* (1986) is a series of essays he wrote about his professional life.


Laurence Olivier

Olivine is any of a group of common rock-forming minerals that consist of silicon, oxygen, magnesium, and iron. Olivine occurs primarily in dark igneous rocks, usually as grainy masses or embedded crystals. It is generally one of the first minerals to crystallize from dark-coloured *magma* (melted rock material).

Most types of olivine range in colour from clear green to yellow-green, but iron-rich varieties may be brown. Olivine is relatively hard and cannot be scratched by a knife. The most common olivine is forsterite, which is rich in magnesium. Clear green olivine used as a gemstone is called *peridot* (see **Peridot**).

Olmedo, José. See **Latin-American literature** (The 1800's).

Olmsted, Frederick Law (1822-1903), was an American landscape architect, city planner, and writer on social issues. Olmsted's career was shaped by his conception of a civilized society. Through his landscape designs and writings, Olmsted attempted to recast the form of America's cities and suburbs, and to promote the refinement and culture he thought the citizens of a republic could attain.

Olmsted's best-known city planning project was Central Park, in New York City. Olmsted and the English architect Calvert Vaux submitted designs for this park in 1858, and Olmsted supervised its construction. He gave the park its most distinctive features—sweeping natural scenery and complete isolation from city traffic. Olmsted and various partners designed Belle Isle Park, Detroit; Mount Royal Park, Montreal; and Roger Williams Park, Providence, Rhode Island.

Olmsted laid out park systems for such U.S. cities as Seattle, Boston, Atlanta, New York, and Louisville (Kentucky). He designed the grounds of the Capitol in Washington, D.C., and planned other public buildings, as well as colleges, suburban developments, and communities, such as Riverside, Illinois.

Olmsted was born in Hartford, Connecticut. His son, Frederick Law Olmsted, Jr., was also a well-known landscape architect and city planner.

Olsen, John, (1928-), one of Australia's leading painters, became known for one major work. This was a maplike painting of the coastal environs of Sydney, entitled "You Beaut Country." Olsen exhibited this work in 1961. Its informal title, coupled with the flowing structure and sensuous colours of the painting, gained it immediate popularity as a national image. "You Beaut Country" appeared and reappeared, with many changes, in several of Olsen's later paintings.

Olsen served as official artist on scientific expeditions to the Northern Territory and the Lake Eyre district. Olsen also painted "Salute to Five Bells," a large mural for the Sydney Opera House. Olsen was born in Newcastle, New South Wales.

Olson, Charles (1910-1970), was one of the most influential American poets of his time. In 1948, Olson began teaching at Black Mountain College, an experimental school in Black Mountain, North Carolina. He served as the school's *rector* (head) from 1951 to 1956. At the college, Olson taught several future major U.S. poets.

Charles John Olson was born in Worcester, Massachusetts. His chief work was a long *cycle* (series of poems) called *The Maximus Poems.* This complex work, the publication of which began in 1953 and ended in 1975 after his death, centres on Gloucester, Massachusetts. Olson used the city symbolically to praise what he admired in human life and to attack the greed and commercialism he saw in American culture.

Olson first gained recognition with *Call Me Ishmael* (1947), a critical study of the American author Herman Melville. Olson's major poems and critical writings appear in *Selected Writings* (1966).

Olympia is a valley about 18 kilometres from Pírgos, Greece. In ancient times, religion, politics, and athletics centred on Olympia. The Olympic games were held there every four years. All the buildings in Olympia were for worship or for games. The religious buildings were clustered in the *Altis* (sacred grove), which lies where the Cladeus River flows into the Alpheus River. They included the temples of Zeus and Hera, the Pelopion, the Philippeion, and the great altars.

The athletic buildings lay just outside the Altis. In the northwest corner was a gymnasium. Joining the gymnasium on the south lay the Palaestra, which was a wrestling and boxing school. To the east stood the great stadium. Southeast of the stadium was the Hippodrome, where chariot and horse races were held.

The Olympic games were prohibited in A.D. 394, and a fort was built inside the Altis. Later, earthquakes and floods covered Olympia with gravel and soil. Finally, it lay beneath 6 metres of earth.

In 1829, a French expedition began excavations at the temple of Zeus. The German government continued this work. Between 1875 and 1879 the entire Altis and many of the surrounding buildings were uncovered. Fragments of sculpture, coins, terracottas, and bronzes have been found. The most important are two statues—the *Victory of Paeonius* (423 B.C.) and the *Hermes of Praxiteles.* A museum with Olympian relics is at Olympia.

See also **Olympic Games.**

Olympiad. In the Greek system of telling time, an Olympiad was the period of four years that elapsed between two successive celebrations of the Olympian, or Olympic, Games. This way of measuring time became common about 300 B.C. All events were dated from 776 B.C., the start of the first known Olympiad.

The beginning of the first year of an Olympiad was determined by the first full moon after the summer solstice, the longest day of the year. This method of counting time ceased about A.D. 440, after the 304th Olympiad. The Olympiads were used as measures of time by Greek historians and other writers to refer to preceding centuries, but they were never in everyday use, as were months and years.

Olympians. See **Mythology** (Greek mythology).

Olympias (375?-316 B.C.) was the wife of Philip II of Macedonia, and the mother of Alexander the Great. A proud and emotional woman, Olympias influenced Alexander greatly. She told him that his real father was the god Zeus-Ammon, not Philip. Olympias feared that Philip might choose another heir. Many people believe that she had Philip killed in order to ensure that Alexander would become king. After Alexander's death in 323 B.C., Olympias tried to keep the empire for her grandson, Alexander IV. She failed, and in 316 B.C. was captured by Cassander, a Macedonian prince. Olympias was eventually killed. See also **Alexander the Great** (His boyhood); **Philip II.**

Paul J. Sutton, Duomo

The opening ceremonies of the Olympic Games feature the entry of the athletes into the stadium. Athletes from Greece enter first, followed by teams from the other countries.

Olympic Games

Olympic Games are the most important international athletic competition in the world. The Olympics bring together thousands of the world's finest athletes to compete against one another in numerous individual and team sports. Millions of people have attended the games, and more than 1 billion people throughout the world watch the Olympics on television.

The Olympic Games originated in ancient Greece and were held from 776 B.C. to A.D. 393. The modern games began in 1896. The organizers revived the games to encourage world peace and friendship and to promote healthy sporting competition for the youth of the world.

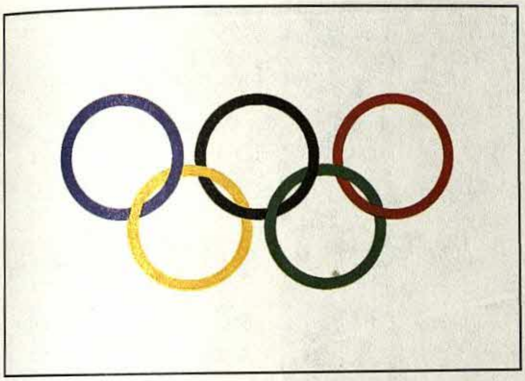
The Olympic Games consist of the Summer Games and the Winter Games. From 1896 to 1992, the Olympics were held every four years, except in 1916 during World War I, and in 1940 and 1944 during World War II. The Winter Games, which were established in 1924, took place the same year as the Summer Games. Beginning in 1994, the Winter and Summer Games were divided and scheduled on four-year cycles two years apart. For the years and locations of the games, see the table *Sites of the Olympic Games* in this article.

Olympic ceremonies and symbols

Colourful ceremonies combine with thrilling athletic competition to create the special feeling of excitement in the Olympics. The opening ceremony is particularly impressive. The Olympic athletes of Greece march into the stadium first, in honour of the original games held in ancient Greece. The athletes of the other countries follow in alphabetical order by country according to the spelling in the language of the host country. The athletes of the host country enter last. The president or other head of state of the host country opens the games. The Olympic flag is raised, trumpets play, and cannons boom in salute. Hundreds of doves are released as a symbol of peace.

The most dramatic moment of the opening ceremony is the lighting of the Olympic flame. The flame symbolizes the light of spirit, knowledge, and life, and it is a messenger of peace. The fire is ignited in Olympia, Greece, by using a mirror to concentrate the rays of the sun. Runners transport the flame in a torch relay from Greece to the site of the games. Most runners carry the flame on foot. However, many other kinds of transportation, including aeroplanes, horses, and skis, have also been used. The final runner carries the torch into the stadium, circles the track, and lights a huge *cauldron* (pot). The flame burns throughout the games and then is extinguished during the closing ceremony.

The Olympic symbol, created in 1913, consists of five interlocking rings that represent the continents of Africa, Asia, Australia, Europe, and the Americas. The flag of every nation competing in the games has at least



The Olympic symbol consists of five interlocking rings that represent Africa, Asia, Australia, Europe, and the Americas.

one of these colours. Under the rings is the Olympic motto, the Latin words *Citius, Altius, Fortius.* The words are translated as *Swifter, Higher, Stronger.*

The International Olympic Committee

The International Olympic Committee (IOC) is the governing body of the Olympic Games. The IOC has headquarters in Lausanne, Switzerland. The committee approves the sports and events to be included in the games. The IOC also selects the host cities for the Summer Games and Winter Games, seven years in advance. The cities bidding for the games must prove they can provide athletic facilities for the games and housing for the athletes, coaches, officials, and visiting spectators. Host cities provide a special housing compound called the Olympic Village for the athletes and coaches. The prospective hosts must also convince the IOC that they can furnish adequate transportation, food service, and cultural activities. Host cities are chosen by a majority vote of the IOC.

Originally, members of the IOC were elected for life. However, according to a rule change in 1995, all members must retire before they reach the age of 81. The members of the IOC are not allowed to accept instructions on voting from any government or other group or individual. New members of the IOC are elected by current members.

Olympic competition

Every country or territory competing in the Olympic Games is represented by a national Olympic committee. In the mid-1990's, about 195 nations and territories had such groups. Each committee is responsible for selecting its national team, providing uniforms and equipment, and furnishing transportation to the Olympic site.

Most countries use government funds to pay their Olympic expenses. The IOC also provides financial aid. The United States is the only large nation whose government does not give its team financial support. The U.S. team is largely financed by contributions from private corporations and individuals.

Selection of the athletes. In many countries, athletes qualify for the Olympics by winning or finishing high in competitions called *selection trials.* In most cases, athletes are invited to the trials based on their performance in national and international competitions.

An athlete representing a country must be a citizen of that country. For many years, only amateur athletes competed in the games. This gave an advantage to wealthy athletes who could devote all their time to training without worrying about earning money. Professional athletes are now eligible to compete in most Olympic sports. Exceptions include baseball and boxing.

Entries. In most Olympic sports, a nation may enter as many as three competitors in each event as long as the athletes meet a minimum standard set by the international governing body of that sport. Team sports are limited to 8 to 16 teams per sport. National teams must win or be placed high in qualifying tournaments to make the final competition. The host country is allowed to enter a team in every team event.

Medals. The top three finishers in each event receive a medal and a diploma. The next five finishers get only a diploma. Each first-place winner receives a gold medal, which is actually made of silver and coated with gold. The second-place medal is made of silver, and the third-place medal is bronze. The design for the medal changes for each Olympics. All members of a winning relay team get a medal, including those who participated only in qualifying rounds. All the members of a winning team who have played in at least one of the games during the competition receive a medal.

The top three finishers receive their medals in a ceremony after the event. The medal winners stand at attention on a platform, with the gold medallist in the middle. The silver medallist stands on the gold medallist's right and the bronze medallist on the left. The flags of their

Sites of the Olympic Games

Year	Summer	Winter
1896	Athens, Greece	Not held
1900	Paris, France	Not held
1904	St. Louis, U.S.A.	Not held
1908	London, England	Not held
1912	Stockholm, Sweden	Not held
1916	Not held	Not held
1920	Antwerp, Belgium	Not held
1924	Paris, France	Chamonix, France
1928	Amsterdam, the Netherlands	St. Moritz, Switzerland
1932	Los Angeles, U.S.A.	Lake Placid, U.S.A.
1936	Berlin, Germany	Garmisch-Partenkirchen, Germany
1940	Not held	Not held
1944	Not held	Not held
1948	London, England	St. Moritz, Switzerland
1952	Helsinki, Finland	Oslo, Norway
1956	Melbourne, Australia	Cortina, Italy
1960	Rome, Italy	Squaw Valley, U.S.A.
1964	Tokyo, Japan	Innsbruck, Austria
1968	Mexico City, Mexico	Grenoble, France
1972	Munich, Germany	Sapporo, Japan
1976	Montreal, Canada	Innsbruck, Austria
1980	Moscow, Soviet Union	Lake Placid, U.S.A.
1984	Los Angeles, U.S.A.	Sarajevo, Yugoslavia
1988	Seoul, South Korea	Calgary, Canada
1992	Barcelona, Spain	Albertville, France
1994		Lillehammer, Norway
1996	Atlanta, U.S.A.	
1998		Nagano, Japan
2000	Sydney, Australia	
2002		Salt Lake City, U.S.A.

Manny Millan, *Sports Illustrated*

The Olympic flame is lit during the opening ceremonies. The fire is ignited in Olympia, Greece, and transported by relay to the site of the games. The flame symbolizes the light of spirit, knowledge, and life, and it is a herald of peace.

David Black

The medal ceremony takes place after the finals of each event. The top three finishers receive a medal and a diploma. They stand at attention on a platform while the flags of their countries are raised and a band plays the national anthem of the country of the gold medal winner.

countries are raised, and a band plays the national anthem of the country of the gold medal winner.

Olympic competition is intended to test the skill of individuals and teams, not nations. Therefore, the IOC does not keep an official score among the nations. No country "wins" the Olympics. However, unofficial medal totals are compiled for the press and the public.

The Summer Games

The Summer Games are held during the summer season of the host city, usually between July and October, and last 16 days. Athletes compete in more than 270 separate events during the Summer Games. A sport must be played in at least 75 countries on four continents before it can be considered for men's competition. To be eligible for women's competition, a sport must be played in 40 countries on three continents.

The Summer Games have grown enormously. In the first modern games in 1896, about 311 male athletes representing 13 nations competed. Today, more than 10,000 male and female athletes representing over 190 nations participate.

Nathan Bilow, Allsport

The closing ceremonies come after the end of the athletic competition. The ceremonies are marked by spectacle and conclude with the extinguishing of the Olympic flame.

The Winter Games

The Winter Games are usually held in February and last 16 days. A sport must be played in at least 25 countries on three continents to be considered. The Winter Olympics include over 60 events. The games attract approximately 2,000 athletes from about 60 countries.

The ancient games

Athletics played an important role in the religious festivals of ancient Greece. Historians believe the ancient Greeks first organized athletic games as part of funeral ceremonies for important people. This practice probably existed by the 1200's B.C. Later, games became part of religious festivals honouring the gods. Many Greek cities held festivals every two or four years.

Over time, four great religious festivals developed that brought together people from throughout the Greek world. These festivals were the Isthmian, Nemean, Pythian, and Olympic games. The Olympic Games, which ranked as the most important, honoured Zeus, the king of the gods.

The first recorded Olympic contest took place in 776 B.C. at Olympia in western Greece. The first winner was Koroibos (also spelled Coroebus), a cook from Elis. The Olympic Games were held every four years. They were so important to the ancient Greeks that time was measured in *Olympiads,* the four-year intervals between games. The only event in the first 13 games was the *stadion,* a running race of 192 metres. Through the years, longer running races were added.

Other types of competition became part of the ancient Olympics. In 708 B.C., wrestling and the pentathlon were added. The pentathlon was a combination of jumping, running, the discus throw, the javelin throw, and wrestling. Boxing joined the programme in 688 B.C., and the four-horse chariot race was added in 680 B.C. Horse racing was included in 648 B.C., as was the *pancratium* (also spelled *pankration*), a combination of boxing, wrestling, and kicking. Some unusual events were included in the Olympics, such as a race in armour, a chariot race called the *apene* in which two mules pulled the chariot, and a competition for trumpeters.

The ancient Olympics produced several famous champions. Milo of Kroton won the wrestling competition five times between 532 and 516 B.C., and Leonidas of Rhodes won three running races in each of four Olympics from 164 to 152 B.C.

The Romans conquered Greece during the 140's B.C., and the games soon lost their religious meaning. In A.D. 393, Emperor Theodosius I banned the games.

The modern games

The modern games begin. In 1875, a group of German archaeologists began to excavate the ruins of the stadium and temples of Olympia, which had been destroyed by an earthquake and buried by a landslide and floods. Their discoveries inspired Baron Pierre de Coubertin, a French educator, to organize a modern international Olympics. He first proposed the idea publicly in 1892. In 1894, the first IOC was formed.

The first modern Olympic Games were held in Athens, Greece, in 1896. The athletes competed in nine sports: (1) cycling, (2) fencing, (3) gymnastics, (4) lawn tennis, (5) shooting, (6) swimming, (7) track and field, (8) weightlifting, and (9) wrestling. James B. Connolly of the United States became the first modern Olympic champion, winning the triple jump (then known as the *hop, step, and jump*).

The games of 1900 and 1904 attracted little attention. The 1900 Olympics were held as part of the Universal Exposition, a world's fair in Paris. Competition was

1994 Winter Olympic Games

Medal-winning nations

Nation	Gold	Silver	Bronze	Total
Norway	10	11	5	26
Germany	9	7	8	24
Russia	11	8	4	23
Italy	7	5	8	20
United States	6	5	2	13
Canada	3	6	4	13
Switzerland	3	4	2	9
Austria	2	3	4	9
South Korea	4	1	1	6
Finland	0	1	5	6
Japan	1	2	2	5
France	0	1	4	5
Netherlands	0	1	3	4
Sweden	2	1	0	3
Kazakhstan	1	2	0	3
China	0	1	2	3
Slovenia	0	0	3	3
Ukraine	1	0	1	2
Belarus	0	2	0	2
United Kingdom	0	0	2	2
Uzbekistan	1	0	0	1
Australia	0	0	1	1

Alpine skiing

Event	Winner	Nation
Men		
Combined	Lasse Kjus	Norway
Downhill	Tommy Moe	United States
Giant slalom	Markus Wasmeier	Germany
Slalom	Thomas Stangassinger	Austria
Super G	Markus Wasmeier	Germany
Women		
Combined	Pernilla Wiberg	Sweden
Downhill	Katja Seizinger	Germany
Giant slalom	Deborah Compagnoni	Italy
Slalom	Vreni Schneider	Switzerland
Super G	Diann Roffe-Steinrotter	United States

Biathlon

Event	Winner	Nation
Men		
10 kilometres	Sergei Tchepikov	Russia
20 kilometres	Sergei Tarasov	Russia
30-kilometre relay	Gross, Luck, Kirchner, Fischer	Germany
Women		
7.5 kilometres	Myriam Bedard	Canada
15 kilometres	Myriam Bedard	Canada
30-kilometre relay	Talanova, Snytina, Noskova, Reztsova	Russia

Bobsledding

Event	Winner	Nation
Two-man	Weder, Acklin	Switzerland
Four-man	Czudaj, Brannasch, Hampel, Szelig	Germany

Cross-country skiing

Event	Winner	Nation
Men		
10 kilometres	Bjorn Daehlie	Norway
15 kilometres	Bjorn Daehlie	Norway
30 kilometres	Thomas Alsgaard	Norway
50 kilometres	Vladimir Smirnov	Kazakhstan
40-kilometre relay	De Zolt, Albarello, Vanzetta, Fauner	Italy
Women		
5 kilometres	Lyubov Egorova	Russia
10 kilometres	Lyubov Egorova	Russia
15 kilometres	Manuela Di Centa	Italy
30 kilometres	Manuela Di Centa	Italy
20-kilometre relay	Valbe, Lazutina, Gavriluk, Egorova	Russia

Figure skating

Event	Winner	Nation
Men	Alexei Urmanov	Russia
Women	Oksana Baiul	Ukraine
Pairs	Ekaterina Gordeeva and Sergei Grinkov	Russia
Ice dancing	Oksana Gristchuk and Evgeni Platov	Russia

Freestyle skiing

Event	Winner	Nation
Aerials (men)	Andreas Schoenbaechler	Switzerland
Aerials (women)	Lina Cherjazova	Uzbekistan
Moguls (men)	Jean-Luc Brassard	Canada
Moguls (women)	Stine Lise Hattestad	Norway

Ice hockey

Winning nation
Sweden

Gerard Vandystadt, Allsport

Nathan Bilow, Allsport

Gold medal winners in the 1994 Winter Games included Oksana Baiul, *left,* and Jean-Luc Brassard, *right.* The 16-year-old Baiul, representing Ukraine, won the women's figure-skating title. Brassard, a Canadian, took the gold medal in the men's mogul event in the freestyle skiing competition.

Luge

Event	Winner	Nation
Single-seater (men)	Georg Hackl	Germany
Single-seater (women)	Gerda Weissensteiner	Italy
Two-seater (men)	Brugger, Huber	Italy

Nordic combined skiing

Event	Winner	Nation
Men		
Individual	Fred Borre Lundberg	Norway
Team	Kono, Abe, Ogiwara	Japan

Ski jumping

Event	Winner	Nation
90 metres	Espen Bredesen	Norway
120 metres	Jens Weissflog	Germany
Team	Jaekle, Duffner, Thoma, Weissflog	Germany

Short-track skating

Event	Winner	Nation	Time
Men			
500 metres	Ji Hoon Chae	South Korea	45.98 s.*
1,000 metres	Jun-Ho Lee	South Korea	1 min. 29.58 s.*
5,000-metre relay	Carnino, Fagone, Herrnhof, Viullermin	Italy	7 min. 11.74 s.*
Women			
500 metres	Cathy Turner	United States	45.98 s.*
1,000 metres	Lee Kyung Chun	South Korea	1 min. 36.87 s.*
3,000-metre relay	Chun, Kim, Kim, Won	South Korea	4 min. 26.64 s.*

*Olympic record.

Focus on Sports

Focus on Sports

Champion speed skaters at the 1994 Winter Games included Johann Olav Koss of Norway, *left,* and Bonnie Blair of the United States, *right.* Koss won the men's 1,500-metre, 5,000-metre, and 10,000-metre races. Blair won the women's 500- and 1,000-metre races. Both skaters set Olympic records in all their victories.

Speed skating

Event	Winner	Nation	Time
Men			
500 metres	Alexander Golubev	Russia	36.33 s.*
1,000 metres	Dan Jansen	United States	1 min. 12.43 s.*
1,500 metres	Johann Olav Koss	Norway	1 min. 51.29 s.*
5,000 metres	Johann Olav Koss	Norway	6 min. 34.96 s.*
10,000 metres	Johann Olav Koss	Norway	13 min. 30.55 s.*
Women			
500 metres	Bonnie Blair	United States	39.25 s.*
1,000 metres	Bonnie Blair	United States	1 min. 18.74 s.*
1,500 metres	Emese Hunyady	Austria	2 min. 2.19 s.*
3,000 metres	Svetlana Bazhanova	Russia	4 min. 17.43 s.*
5,000 metres	Claudia Pechstein	Germany	7 min. 14.57 s.*

*Olympic record.

1992 Summer Olympic Games

Leading medal-winning nations

Nation	Gold	Silver	Bronze	Total
Unified Team†	45	38	29	112
United States	37	34	37	108
Germany	33	21	28	82
China	16	22	16	54
Cuba	14	6	11	31
Hungary	11	12	7	30
South Korea	12	5	12	29
France	8	5	16	29
Australia	7	9	11	27
Spain	13	7	2	22
Japan	3	8	11	22

†Formerly the Soviet Union.

Winners of team sports

Sport	Nation
Baseball	Cuba
Basketball (men)	United States
Basketball (women)	Unified Team
Hockey (men)	Germany
Hockey (women)	Spain
Handball (men)	Unified Team
Handball (women)	South Korea
Soccer (men)	Spain
Volleyball (men)	Brazil
Volleyball (women)	Cuba
Water polo (men)	Italy

Archery

Winner	Nation
Sebastien Flute (men)	France
Cho Youn Jeong (women)	South Korea
Team (men)	Spain
Team (women)	South Korea

Badminton

Event	Winner	Nation
Singles (men)	Alan Budi Kushuma	Indonesia
Singles (women)	Susi Susante	Indonesia
Doubles (men)	Kim Moon So, Park Joo Bong	South Korea
Doubles (women)	Hwang Hae Young, Chung So Young	South Korea

Continued on next page.

Boxing

Class	Winner	Nation
Light flyweight	Rogelio Marcelo	Cuba
Flyweight	Su Choi Choi	North Korea
Bantamweight	Joel Casamayor	Cuba
Featherweight	Andreas Tews	Germany
Lightweight	Oscar De La Hoya	United States
Light welterweight	Hector Vinent	Cuba
Welterweight	Michael Carruth	Ireland
Light middleweight	Juan Lemus	Cuba
Middleweight	Ariel Hernandez	Cuba
Light heavyweight	Torsten May	Germany
Heavyweight	Felix Savon	Cuba
Super heavyweight	Roberto Balado	Cuba

Canoeing and kayaking

Event	Winner	Nation
Men		
Single kayak slalom	Pierpaolo Ferrazzi	Italy
Kayak 500-metre singles	Mikko Kolehmainen	Finland
Kayak 500-metre doubles	Bluhm, Gutsche	Germany
Kayak 1,000-metre singles	Clint Robinson	Australia
Kayak 1,000-metre doubles	Bluhm, Gutsche	Germany
Kayak 1,000-metre fours	Von Appen, Kegel, Reineck, Wohllebe	Germany
Double canoe slalom	Jacobi, Strausbaugh	United States
Canoe slalom	Lukas Pollert	Czechoslovakia
Canoe 500-metre singles	Nikolai Boukhalov	Bulgaria
Canoe 500-metre doubles	Masseikov, Dovgalenok	Unified Team
Canoe 1,000-metre singles	Nikolai Boukhalov	Bulgaria
Canoe 1,000-metre doubles	Papke, Spelly	Germany
Women		
Kayak slalom	Elisabeth Micheler	Germany
Kayak 500-metre singles	Birgit Schmidt	Germany
Kayak 500-metre doubles	Portwich, Von Seck	Germany
Kayak 500-metre fours	Donusz, Czigany, Meszaros, Koban	Hungary

Cycling

Event	Winner	Nation
Men		
Individual road race	Fabio Casartelli	Italy
Sprint	Jens Fiedler	Germany
1,000-metre time trial	Jose Moreno	Spain
4,000-metre individual pursuit	Chris Boardman	United Kingdom
4,000-metre team pursuit	Gloeckner, Lehmann, Steinweg, Walzer	Germany
100-kilometre team time trial	Dittert, Meyer, Peschel, Rich	Germany
50-kilometre points race	Giovanni Lombardi	Italy
Women		
79-kilometre road race	Kathryn Watt	Australia
Sprint	Erika Salumae	Estonia
Pursuit	Petra Rossner	Germany

Equestrian

Event	Winner	Nation
Three-day, team	Green, Rolton, Hoy	Australia
Three-day, individual	Matthew Ryan	Australia
Dressage, team	Uphoff, Theodorescu, Werth	Germany
Dressage, individual	Nicole Uphoff	Germany
Prix des nation, individual	Ludger Beerbaum	Germany
Prix des nation, team	Lansink, Raymakers, Romp	Netherlands

Fencing

Individual competition

Event	Winner	Nation
Foil (men)	Philippe Omnes	France
Foil (women)	Giovanna Trillini	Italy
Epee (men)	Eric Srecki	France
Sabre (men)	Bence Szabo	Hungary

Team competition

Event	Winning nation
Foil (men)	Germany
Foil (women)	Italy
Epee (men)	Germany
Sabre (men)	Unified Team

Gymnastics

Event	Winner	Nation
Men		
All-around	Vitali Scherbo	Unified Team
Long horse vault	Vitali Scherbo	Unified Team
Pommel horse	(tie) Vitali Scherbo, Pae Gil Su	Unified Team North Korea
Horizontal bar	Trent Dimas	United States
Parallel bars	Vitali Scherbo	Unified Team
Rings	Vitali Scherbo	Unified Team
Floor exercise	Li Xiaosahuang	China
Team		Unified Team
Women		
All-around	Tatiana Goutsou	Unified Team
Balance beam	Tatiana Lyssenko	Unified Team
Uneven parallel bars	Lu Li	China
Side horse vault	(tie) Henrietta Onodi, Lavinia Milosovici	Hungary Romania
Floor exercise	Lavinia Milosovici	Romania
Team		Unified Team
Rhythmic	Alexandra Timoshenko	Unified Team

Judo

Class	Winner	Nation
Men		
60 kilograms or less	Nazim Gousseinov	Unified Team
65 kilograms or less	Rogerio Sampaio	Brazil
71 kilograms or less	Toshihiko Koga	Japan
78 kilograms or less	Hidehiko Yoshida	Japan
86 kilograms or less	Waldemar Legien	Poland
95 kilograms or less	Antal Kovacs	Hungary
over 95 kilograms	David Khakhaleichvili	Unified Team
Women		
48 kilograms or less	Cecile Nowak	France
52 kilograms or less	Almudena Munoz Martinez	Spain
56 kilograms or less	Miriam Blasco Soto	Spain
61 kilograms or less	Catherine Fluery	France
66 kilograms or less	Odalis Reve	Cuba
72 kilograms or less	Kim Mi Jung	South Korea
over 72 kilograms	Zhuang Xiaoyan	China

Modern pentathlon

Individual winner	Team winner
Arkadiusz Skrzypaszek, Poland	Poland

Rowing

Event	Winner	Nation
Men		
Single sculls	Thomas Lange	Germany
Double sculls	Hawkins, Antonie	Australia
Four sculls	Willms, Hajek, Volkert, Steinbach	Germany
Pairs without coxswain	Redgrave, Pinsent	United Kingdom
Pairs with coxswain	Searle, Searle, Herbert	United Kingdom
Fours without coxswain	Cooper, McKay, Green, Tomkins	Australia
Fours with coxswain	Talapan, Ruican, Popescu, Taga, Raducanu	Romania
Eights with coxswain	Wallace, Robertson, Forgeron, Barber, Marland, Rascher, Crosby, Porter, Paul	Canada
Women		
Single sculls	Elisabeta Lipa	Romania
Double sculls	Koeppen, Boron	Germany
Pairs without coxswain	McBean, Heddle	Canada
Four sculls	Mueller, Schmidt, Peter, Mundt	Germany
Fours without coxswain	Barnes, Taylor, Monroe, Worthington	Canada
Eights with coxswain	Barnes, Taylor, Delehanty, Crawford, McBean, Worthington, Monroe, Heddle, Thompson	Canada

Shooting

Event	Winner	Nation
Men		
Free pistol	Konstantine Loukachik	Unified Team
Rapid-fire pistol	Ralf Schumann	Germany
Small bore rifle—prone position	Lee Eun Chul	South Korea
Small bore rifle—three positions	Gracha Petikian	Unified Team
Running game target	Michael Jakosits	Germany
Air rifle	Iouri Fedkine	Unified Team
Air pistol	Wang Yifu	China
Women		
Air rifle	Yeo Kab Soon	South Korea
Small bore rifle—three positions	Launi Meili	United States
Sport pistol	Marina Logvinenko	Unified Team
Air pistol	Marina Logvinenko	Unified Team
Open		
Skeet	Zhang Shan	China
Trapshooting	Petr Hrdlicka	Czechoslovakia

Steven E. Sutton, Duomo

Vitali Scherbo of the Unified Team tied for the gold medal in the pommel horse competition in men's gymnastics.

Swimming and diving

Event	Winner	Nation	Time
Men			
50-metre freestyle	Alexander Popov	Unified Team	21.91 s.*
100-metre freestyle	Alexander Popov	Unified Team	49.02 s.
200-metre freestyle	Evgueni Sadovyi	Unified Team	1 min. 46.70 s.*
400-metre freestyle	Evgueni Sadovyi	Unified Team	3 min. 45.00 s.*
1,500-metre freestyle	Kieren Perkins	Australia	14 min. 43.48 s.*
100-metre backstroke	Mark Tewksbury	Canada	53.98 s.*
200-metre backstroke	Martin Lopez-Zubero	Spain	1 min. 58.47 s.*
100-metre breaststroke	Nelson Diebel	United States	1 min. 01.50 s.*
200-metre breaststroke	Mike Barrowman	United States	2 min. 10.16 s.*
100-metre butterfly	Pablo Morales	United States	53.32 s.
200-metre butterfly	Melvin Stewart	United States	1 min. 56.26 s.*
200-metre medley	Tamas Darnyi	Hungary	2 min. 00.76 s.
400-metre medley	Tamas Darnyi	Hungary	4 min. 14.23 s.*
400-metre medley relay	Rouse, Diebel, Morales, Olsen	United States	3 min. 36.93 s.*
400-metre freestyle relay	Hudepohl, Biondi, Jager, Olsen	United States	3 min. 16.74 s.
800-metre freestyle relay	Lepikov, Pychnenko, Taianovitch, Sadovyi	Unified Team	7 min. 11.95 s.*
Platform diving	Sun Shuwei	China	
Springboard diving	Mark Lenzi	United States	
Women			
50-metre freestyle	Yang Wenyi	China	24.79 s.*
100-metre freestyle	Zhuang Yong	China	54.65 s.*
200-metre freestyle	Nicole Haislett	United States	1 min. 57.90 s.
400-metre freestyle	Dagmar Hase	Germany	4 min. 07.18 s.
800-metre freestyle	Janet Evans	United States	8 min. 25.52 s.
100-metre backstroke	Krisztina Egerszegi	Hungary	1 min. 00.68 s.*
200-metre backstroke	Krisztina Egerszegi	Hungary	2 min. 07.06 s.*
100-metre breaststroke	Elena Roudkovskaia	Unified Team	1 min. 08.00 s.
200-metre breaststroke	Kyoko Iwasaki	Japan	2 min. 26.65 s.*
100-metre butterfly	Quian Hong	China	58.62 s.*
200-metre butterfly	Summer Sanders	United States	2 min. 08.67 s.
200-metre medley	Lin Li	China	2 min. 11.65 s.*
400-metre medley	Krisztina Egerszegi	Hungary	4 min. 36.54 s.
400-metre freestyle relay	Haislett, Torres, Martino, Thompson	United States	3 min. 39.46 s.*
400-metre medley relay	Loveless, Nall, Ahmann-Leighton, Thompson	United States	4 min. 02.54 s.*
Synchronized swimming (solo)	Kristen Babb-Sprague	United States	
Synchronized swimming (duet)	Josephson, Josephson	United States	
Platform diving	Fu Mingxia	China	
Springboard diving	Gao Min	China	

*Olympic record.

Continued on next page.

Table tennis

Event	Winner	Nation
Singles (men)	Jan Ove Waldner	Sweden
Singles (women)	Deng Yaping	China
Doubles (men)	Lu Lin, Wang Tao	China
Doubles (women)	Deng Yaping, Qiao Hong	China

Tennis

Event	Winner	Nation
Singles (men)	Marc Rosset	Switzerland
Singles (women)	Jennifer Capriati	United States
Doubles (men)	Becker, Stich	Germany
Doubles (women)	Fernandez, Fernandez	United States

Focus on Sports

William R. Sallaz, Duomo

Gold medal winners in the 1992 Summer Olympics included Pablo Morales, *above,* Mark Lenzi, *left,* and Jennifer Capriati, *below.* All three competed for the United States. Morales won the men's 100-metre butterfly race in swimming. Lenzi was the men's springboard diving champion. Capriati won the women's singles title in tennis.

Focus on Sports

Track and field

Event	Winner	Nation	Time or distance
Men			
100 metres	Linford Christie	United Kingdom	9.96 s.
200 metres	Mike Marsh	United States	20.01 s.
400 metres	Quincy Watts	United States	43.50 s.*
800 metres	William Tanui	Kenya	1 min. 43.66 s.
1,500 metres	Fermin Cacho	Spain	3 min. 40.12 s.
5,000 metres	Dieter Baumann	Germany	13 min. 12.52 s.
10,000 metres	Khalid Skah	Morocco	27 min. 46.70 s.
110-metre hurdles	Mark McKoy	Canada	13.12 s.
400-metre hurdles	Kevin Young	United States	46.78 s.*
3,000-metre steeplechase	Matthew Birer	Kenya	8 min. 08.84 s.
Marathon	Hwang Young Cho	South Korea	2 h. 13 min. 23 s.
400-metre relay	Marsh, Burrell, Mitchell, C. Lewis	United States	37.40 s.*
1,600-metre relay	Valmon, Watts, Johnson, S. Lewis	United States	2 min. 55.74 s.*
20-kilometre walk	Daniel Plaza Montero	Spain	1 h. 21 min. 45 s.
50-kilometre walk	Andrei Perlov	Unified Team	3 min. 50.13 s.
High jump	Javier Sotomayor	Cuba	2.34 m
Long jump	Carl Lewis	United States	8.67 m
Triple jump	Mike Conley	United States	17.63 m*
Pole vault	Maksim Tarasov	Unified Team	5.80 m
Discus	Romas Ubartas	Lithuania	65.13 m
Javelin	Jan Zelezny	Czechoslovakia	89.66 m*
Shot-put	Michael Stulce	United States	21.70 m
Hammer	Andrei Abduvaliyev	Unified Team	85.52 m
Decathlon	Robert Zmelik	Czechoslovakia	8,611 pts.
Women			
100 metres	Gail Devers	United States	10.82 s.
200 metres	Gwen Torrence	United States	21.81 s.
400 metres	Marie-Jose Perec	France	48.83 s.
800 metres	Ellen Van Langen	Netherlands	1 min. 55.54 s.
1,500 metres	Hassiba Boulmerka	Algeria	3 min. 55.30 s.
3,000 metres	Elena Romanova	Unified Team	8 min. 46.04 s.
10,000 metres	Derartu Tulu	Ethiopia	31 min. 06.02 s.
100-metre hurdles	Paraskevi Patoulidou	Greece	12.64 s.
400-metre hurdles	Sally Gunnell	United Kingdom	53.23 s.
400-metre relay	Ashford, Jones, Guidry-White, Torrence	United States	42.11 s.
1,600-metre relay	Ruzina, Dzhigalova, Nazarova, Bryzgina	Unified Team	3 min. 20.20 s.
10-kilometre walk	Chen Yueling	China	44 min. 32 s.*
High jump	Heike Henkel	Germany	2.02 m
Long jump	Heike Drechsler	Germany	7.14 m
Discus	Maritza Marten	Cuba	70.06 m
Javelin	Silke Renk	Germany	68.33 m
Shot-put	Svetlana Krivaleva	Unified Team	21.06 m
Marathon	Valentina Yegorova	Unified Team	2 h. 32 min. 41 s.
Heptathlon	Jackie Joyner-Kersee	United States	7,044 pts.

*Olympic record.

Weightlifting

Class	Winner	Nation	Weight
52 kilograms or less	Ivan Ivanov	Bulgaria	265 kg
56 kilograms or less	Chun Byung Kwan	South Korea	287.5 kg
60 kilograms or less	Naim Suleymanoglu	Turkey	320 kg
68 kilograms or less	Israel Militossian	Unified Team	337.5 kg
75 kilograms or less	Fedor Kassapu	Unified Team	357.5 kg
83 kilograms or less	Pyrros Dimas	Greece	370 kg
90 kilograms or less	Kakhi Kakhiachvili	Unified Team	412.5 kg*
100 kilograms or less	Victor Tregoubov	Unified Team	410 kg
110 kilograms or less	Ronny Weller	Germany	432.5 kg
Over 110 kilograms	Alexander Kourlovitch	Unified Team	450 kg

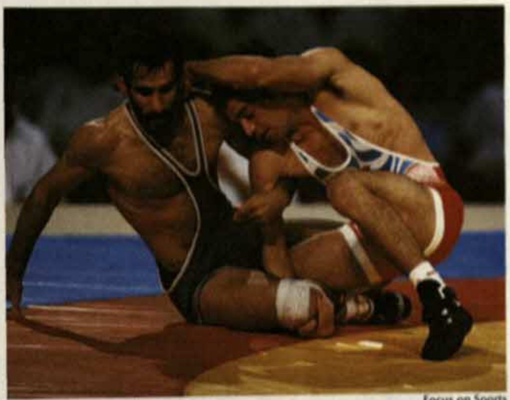
*Ties Olympic record. Weight is total of two lifts, snatch and clean and jerk.

Focus on Sports

Focus on Sports

Track and field stars of the 1992 Summer Olympics included Jackie Joyner-Kersee, *upper left,* and Carl Lewis, *upper right,* of the United States. Joyner-Kersee won the heptathlon, a competition she also won in the 1988 games. In addition, she finished third in the women's long jump. Lewis won the men's long jump and was a member of the winning U.S. 400-metre relay team. The U.S. men's 1,600-metre relay team also won a gold medal. In the picture below, Michael Johnson receives the baton from Quincy Watts during the finals of the 1,600-metre race. Both U.S. men's relay teams set Olympic and world records in winning their events.

Paul J. Sutton, Duomo


Focus on Sports

John Smith of the United States won the gold medal in the 62 kilograms or less freestyle wrestling competition. He defeated Agari Mohammadian, *in black,* of Iran in the finals.

Wrestling

Class	Winner	Nation
Freestyle		
48 kilograms or less	Kim Il	North Korea
52 kilograms or less	Li Hak Son	South Korea
57 kilograms or less	Alejandro Puerto	Cuba
62 kilograms or less	John Smith	United States
68 kilograms or less	Arsen Fadzaev	Unified Team
74 kilograms or less	Park Jang Soon	South Korea
82 kilograms or less	Kevin Jackson	United States
90 kilograms or less	Makharbek Khadartsev	Unified Team
100 kilograms or less	Leri Khabelov	Unified Team
Over 100 kilograms	Bruce Baumgartner	United States

Class	Winner	Nation
Greco-Roman style		
48 kilograms or less	Oleg Koutcherenko	Unified Team
52 kilograms or less	Jon Ronningen	Norway
56 kilograms or less	Ahn Han Bong	South Korea
62 kilograms or less	Akif Pirim	Turkey
68 kilograms or less	Attila Repka	Hungary
74 kilograms or less	Mnatsakan Iskandarian	Unified Team
82 kilograms or less	Peter Farkas	Hungary
90 kilograms or less	Maik Bullmann	Germany
100 kilograms or less	Hector Milian	Cuba
130 kilograms or less	Alexander Kareline	Unified Team

Yachting

Class	Winner	Nation
Men		
Finn	Jose van der Ploeg	Spain
Flying Dutchman	Doreste, Manrique	Spain
Soling	Bank, Secher, Seier	Denmark
Star	Reynolds, Haenel	United States
Tornado	Loday, Henard	France
Sailboard	Franck David	France
470	Calafat, Sanchez	Spain
Women		
Europe	Linda Andersen	Norway
Sailboard	Barbara Kendall	New Zealand
470	Zabell, Guerra	Spain

spread out over five months. Attendance was poor, and some athletes did not even realize they had participated in the Olympics. The 1900 Olympics included the first competitions involving women, in lawn tennis and golf. The first women gold medallists were British tennis player Charlotte Cooper and American golfer Margaret Abbott. Poor attendance and other problems also plagued the 1904 Olympics, held as part of the Louisiana Purchase Exposition in St. Louis, U.S.A.

In the early years of the Olympics, competitions were held in several sports that were later dropped. They included polo, croquet, tug of war, live pigeon shooting, the high jump on horseback, and a swimming obstacle race.

The Olympic movement might have died except for the *Intercalated,* or *Interim,* Games held in Athens in 1906. The IOC did not consider these games official. However, they were popular and held the movement together until the next official games in London in 1908. The most dramatic moment of the 1908 games came in the marathon. Dorando Pietri of Italy entered the stadium in first place but collapsed before reaching the finish line. Officials dragged Pietri across the finish line and declared him the winner, but he was later disqualified because he did not finish under his own power.

The 1912 Olympics in Stockholm, Sweden, were the first well-organized Olympic Games. The hero of Stockholm was Jim Thorpe, an American Indian who easily won the 10-event decathlon and the 5-event pentathlon. Thorpe's medals were taken away after it was discovered that he had played baseball for a small salary before the games, making him a professional athlete and therefore ineligible for the Olympics. In 1982, the IOC voted to return the medals to Thorpe's family and put his name back in the record books as an Olympic champion.

Between the wars. The 1916 games were cancelled because of World War I (1914-1918). The 1920 Olympics in Antwerp, Belgium, marked the first appearance of the great Finnish distance runner Paavo Nurmi. He competed in all three Olympics of the 1920's, winning nine gold medals.

Figure skating was included in the 1908 games, and both figure skating and ice hockey were part of the 1920 games. The first separate Winter Games took place in Chamonix, France, in 1924, with 281 men and 13 women representing 16 countries.

The 1924 Summer Games were held in Paris. One of the stars was American swimmer Johnny Weissmuller, who later became famous portraying Tarzan in feature films. Other famous athletes included British sprinters Harold Abrahams and Eric Liddell, later portrayed in the film *Chariots of Fire* (1981).

The 1928 Summer Games, held in Amsterdam, the Netherlands, were the first in which women competed in track and field. In the Winter Games in St. Moritz, Switzerland, Sonja Henie of Norway won her first gold medal in women's figure skating. She was also champion in the 1932 and 1936 Winter Games before becoming a star of Hollywood musicals.

The 1932 Summer Games were held in Los Angeles. These games introduced automatic timing for races and the photo-finish camera. The first Olympic Village was also erected.

Black-figure painting (about 530 B.C.) on a Greek vase; The Metropolitan Museum of Art, New York City, Rogers Fund, 1914

The ancient Olympic Games were held every four years in Olympia in western Greece. The first recorded games took place in 776 B.C. For the first 13 competitions, the only event was a running race for male athletes, *above,* of 192 metres. Other events were added over the years.

In 1931, the IOC chose Berlin, Germany, as the site for the 1936 Summer Games and Garmisch-Partenkirchen, Germany, for the Winter Games. Two years later, Adolf Hitler and his Nazi Party rose to power in Germany. As Hitler's policies became known, there were pleas to move the Summer Games, but the IOC refused.

The Berlin games were the first to be preceded by a torch relay of the Olympic flame from Greece, and they were the first games to be shown on television. But the 1936 Summer Olympics are best remembered for Hitler's failed attempt to use them to prove his theory of racial superiority. The Nazis glorified the Germans and other northern European peoples, while claiming that Jews, blacks, and other groups were inferior. But the most successful athlete in the Summer Games was Jesse Owens, an African American who won four gold medals in track and field. The German spectators, ignoring Hitler's speeches against black people, treated Owens as their favourite hero of the games.

The postwar games. The Olympics scheduled for 1940 and 1944 were cancelled because of World War II (1939-1945). The first postwar Summer Games were held in London in 1948 and the Winter Games again in St. Moritz. The most popular athlete in the Summer Games was Fanny Blankers-Koen of the Netherlands, who won four gold medals in track and field. A star of the Winter Games was Dick Button of the United States, who won the gold medal in figure skating, an achievement he repeated in the 1952 games.

Athletes from the Soviet Union made their first Olympic appearance in the 1952 Summer Games in Helsinki, Finland. By the 1956 games, Soviet athletes were winning more medals than the athletes of any other country. In Helsinki, Emil Zátopek of Czechoslovakia became the only runner to win the 5,000 metres, 10,000 metres, and marathon races in the same Olympics.

The 1956 Summer Games were held in Melbourne, Australia, the first to be held in the Southern Hemisphere. Because of Australian quarantine laws concerning horses, the equestrian events were staged separately in Stockholm. In the weeks preceding the Melbourne games, Israel invaded Egypt and Soviet troops invaded Hungary. These actions led to the first boycotts of the modern Olympics. Egypt, Iraq, and Lebanon withdrew to protest against the Israeli take-over of the Suez Canal. The Netherlands and Spain boycotted to protest against the Soviet invasion.

The 1960 Winter Games at Squaw Valley in California and the Summer Games in Rome were the first to be televised to the United States. The track and field stars of the Summer Games included American sprinter Wilma Rudolph and marathon winner Abebe Bikila of Ethiopia, the first black African to win a gold medal. American boxer Cassius Clay won the light heavyweight gold medal. He later gained international fame as professional boxer Muhammad Ali.

In 1964, the Summer Games were held in Tokyo, the first Asian city to serve as host. Ukrainian gymnast Larissa Latynina won six medals. In her career, she won a record 18 Olympic medals. The Tokyo games were the last Summer Games for more than 20 years to be free of major controversy.

The 1968 games. The 1968 Summer Games were held in Mexico City during a period of political turmoil throughout the world. The most controversial episode took place during the medal ceremony for the men's 200-metre sprint. The gold and bronze medals were won by African American sprinters Tommie Smith and John Carlos. To protest against what they considered to be racism in the United States, both athletes bowed their heads and raised clenched fists during the playing of the U.S. national anthem. At the insistence of the IOC, the U.S. Olympic Committee suspended both men from the Olympic team and ordered them to leave the Olympic Village.

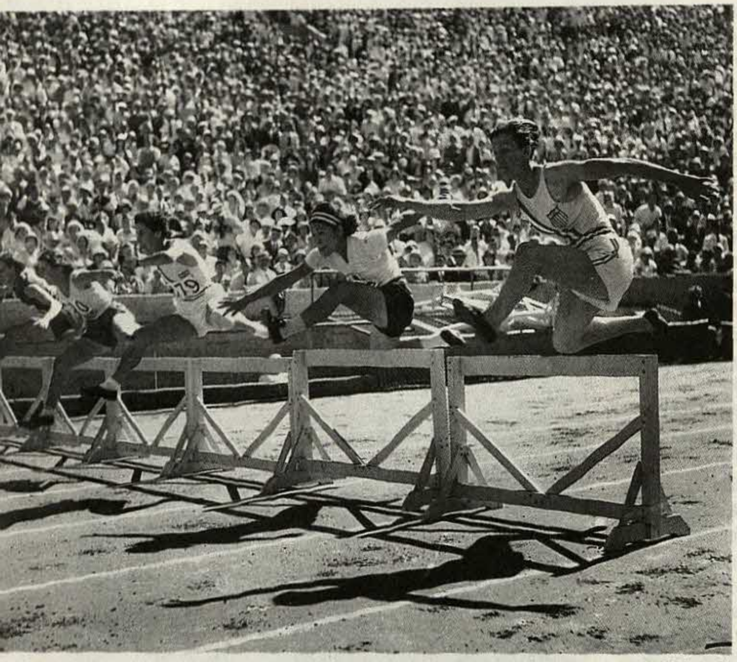
Hulton Deutsch from All Sport

Jim Thorpe of the United States won the decathlon and pentathlon at the 1912 Summer Games. His medals were taken away after he was declared ineligible, but they were restored in 1982.

Mexico City's high altitude was disastrous for athletes in long-distance races and other endurance events, but it contributed to world records in many other contests. The most famous record was 8.90 metres in the long jump, set by Bob Beamon of the United States. The jump became a new world record that lasted for 23 years.

The 1968 Winter Games in Grenoble, France, produced one of the great Olympic heroes of the 1960's. French skier Jean-Claude Killy won three gold medals and became an international celebrity.

Terrorism in Munich. The 1972 Summer Games were held in Munich, in what was then West Germany. The Munich Olympics are remembered for the events of September 5. Eight Palestinian terrorists broke into the Olympic Village and entered the dormitory of the Israeli team. They killed two Israelis and took nine hostages, demanding the release of more than 200 Arab prisoners in Israel. During a battle with West German security forces, all the Israeli hostages were killed, along with five terrorists and one policeman.



AP/Wide World

Allsport

Early women Olympic stars included Babe Didrikson of the United States and Sonja Henie of Norway. Didrikson, *running second from the left,* won the hurdles in the 1932 Summer Games. She also won the javelin throw and finished second in the high jump. Henie, *right,* won the gold medal in figure skating in 1928, 1932, and 1936, the only woman to win the event three times.

The highlight of the competition was swimmer Mark Spitz of the United States, who won seven gold medals. The Soviet Union also won a controversial victory over the U.S. men's basketball team in the championship game. The Americans led by 1 point when the buzzer sounded to end the game. But the officials twice ordered the game to continue, first for 1 second and then for 3 seconds more, enabling the Soviet team to score the winning basket.

Boycotts. The 1976 Summer Games, held in Montreal, Canada, were hit by a boycott led by Tanzania. More than 20 African nations and 2 other countries refused to compete. The boycotters demanded that New Zealand be banned from competition because a New Zealand rugby team had toured South Africa. At that time, South Africa had a white-controlled government that enforced a policy of rigid racial segregation called *apartheid.* South Africa was barred from the Olympics, but the IOC said it had little control over the travel of rugby teams because rugby was not an Olympic sport.

In spite of the boycotts, the 1976 games were filled with outstanding performances. A 14-year old gymnast from Romania named Nadia Comaneci caused a sensation by earning the first perfect score of 10 ever awarded in the Olympics. She eventually earned seven scores of 10 and won three gold medals.

The 1980 Summer Games in Moscow were disrupted by another boycott, this one led by U.S. President Jimmy Carter. The boycott protested against the Soviet Union's 1979 invasion of Afghanistan. About 55 nations stayed away as part of the protest.

The 1980 Winter Games in Lake Placid, New York, were among the most exciting in history. Eric Heiden won all five speed-skating races, setting an Olympic or world record in each race. He became the first athlete to win five individual gold medals in one Olympics. Mark Spitz had won three of his seven gold medals as a member of a winning relay team.

Also at the 1980 Winter Games, the United States ice hockey team won an unexpected gold medal. The United States' team upset the Soviet Union team in an emotional semifinal match and then defeated Finland in the final match.

The games returned to Los Angeles in 1984. With the games being held in the United States, the Soviet Union launched a revenge boycott. Only 13 countries joined the boycott, but they included such sports powers as Bulgaria, East Germany, Cuba, and Hungary. However, China competed in the Olympics for the first time in more than 30 years. China was led by the popular gymnast Li Ning, who won six medals. United States track and field star Carl Lewis matched Jesse Owens's 1936 feat of winning four gold medals.

Charges of steroid use. The 1988 Summer Games were held in Seoul, South Korea, and were boycotted by North Korea and Cuba. Instead of political controversy, disputes over the use of drugs called *anabolic steroids* marked the 1988 games. Anabolic steroids are artificial forms of male hormones used to increase strength and weight. Their use is banned in Olympic competition. Since 1968, the IOC has tested athletes for steroids and other performance-enchancing drugs.

In the 1988 Olympics, Ben Johnson of Canada defeated Carl Lewis in the 100-metre sprint and set a world record. Three days later, the IOC announced that Johnson had tested positive for steroids and was disqualified. Lewis was awarded the gold medal, thus becoming the first man to win the 100-metre sprint twice. He also won the long jump for the second time. Other notable performers were swimmers Matt Biondi of the United States, who won five gold medals, and Kristin Otto of East Germany, who won six.

In the 1988 Winter Games in Calgary, Canada, Katarina Witt of East Germany won the women's figure-skating title. Witt had also won the event in 1984. She was the first woman to repeat as champion since Sonja Henie.

The recent games. The 1992 Summer Games in Barcelona, Spain, reflected the breakup of the Soviet Union and the collapse of Communist governments in Eastern Europe. Germany entered a unified team representing the former countries of East and West Germany. The Baltic states of Estonia, Latvia, and Lithuania, previously part of the Soviet Union, competed as separate nations. Russia and other former Soviet republics competed as the Unified Team. However, when athletes from the Unified Team won a medal, they were honoured by the raising of the flag of their own republic and by the playing of their own national anthem. South Africa, which had ended apartheid, rejoined the Olympics and competed for the first time since 1960.

The 1992 Olympics also marked the first time that professional basketball players were eligible for the competition. This rule change led to the creation of a U.S. "Dream Team" that included Magic Johnson, Larry Bird, Michael Jordan, Charles Barkley, and other stars of the National Basketball Association. The American team easily won the gold medal.

The star competitor of the 1994 Winter Games, was Johann Olav Koss, a speed skater from Norway. In world record times, he won gold medals in the three longest male speed skating races.

Wide World

Jesse Owens of the United States was the hero of the 1936 Summer Games. Owens won four gold medals in track and field.

Bob Martin, All Sport

Katarina Witt represented Germany in the 1988 Winter Games, where she won the women's figure-skating title. Witt had also won the event in the previous Winter Olympics.

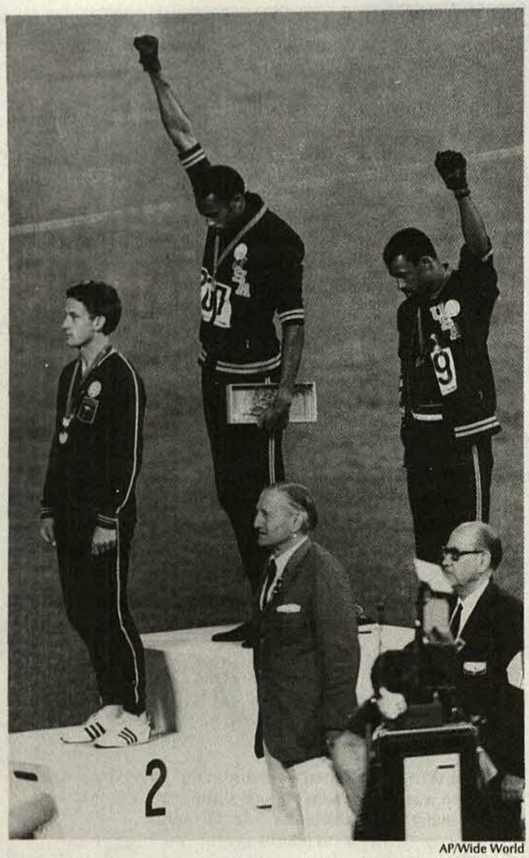
The games were not without controversy. Tonya Harding, one of the two leading U.S. figure skating contestants, was accused of conspiring to assault Nancy Kerrigan, the other leading contestant, during an Olympic qualifying tournament. Harding was allowed to compete in the Games, but came only eighth. Kerrigan went on to win the silver medal.

Related articles. *World Book* has separate articles on many Olympic sports, including gymnastics, ice skating, swimming, and athletics. See also the following:

Flag (picture: Flags of world organizations)
Horse (Horse shows and sports)
Lewis, Carl
Olympia
Olympiad
Owens, Jesse
Thompson, Daley
Thorpe, Jim
Zaharias, Babe Didrikson

Outline

I. Olympic ceremonies and symbols
II. The International Olympic Committee
III. Olympic competition
  A. Selection of the athletes
  B. Entries
  C. Medals
IV. The Summer Games
V. The Winter Games
VI. The ancient games
VII. The modern games



AP/Wide World

Controversy erupted in 1968 when American sprinters Tommie Smith, *centre,* and John Carlos raised clenched fists at a medal ceremony to protest against what they saw as racism.

Questions

What are the five colours of the Olympic symbol?
Why did the United States boycott the 1980 Summer Games?
How is an Olympic host nation chosen?
How many days do the Summer and Winter Games last?
When did the ancient games begin? The modern games?
What are anabolic steroids? Why do some athletes choose to use them?
How many finishers receive a medal in an Olympic event?
Who was Baron Pierre de Coubertin?
What "first" did Nadia Comaneci achieve in the 1976 Summer Games?
What is the Olympic Village?

Olympic Mountains are part of the Pacific Coast Ranges, in the United States of America. The Olympics rise in northern Washington and occupy an area of about 9,060 square kilometres, most of which lies in Olympic National Park.

Mount Olympus (2,428 metres) is the highest peak. There are over 100 small glaciers in the mountains. Forests of spruce, fir, cedar, and hemlock cover the lower slopes. The southwestern slopes receive over 356 centimetres of rain a year.

Olympics. See **Olympic Games.**

Olympus is the highest mountain in Greece. It rises to 2,917 metres at the eastern edge of the ridge which divides Thessaly from Macedonia. Its height and roughness made the early Greeks believe that it was the home of the gods. They believed the 12 major *deities* (gods and goddesses) had palaces on the many peaks of the broad summit of the mountain.

Later the Greek people came to believe that Mount Olympus was not a fit home for the deities. It was usually covered with snow and hidden behind fog and clouds. Their voyages were also showing them that Olympus was not the exact centre of the world as they had thought it was. They were beginning to be able to climb the mountain, and it was not good to have the

Focus on Sports

Paul J. Sutton, Duomo

Great moments in Olympic competition occurred in the 1976 and 1980 games. In the 1976 Summer Games, Nadia Comaneci of Romania, *left,* became the first gymnast in Olympic history to score a perfect 10. In the 1980 Winter Games, the United States ice hockey team upset the Soviet team in the semifinals, *right,* and then defeated Finland to win the gold medal.

Andrew Bernstein, *Sports Illustrated*

The "Dream Team" was the name given to the American men's basketball team that won the gold medal at the 1992 Summer Games. The stars of the team came from the National Basketball Association. The 1992 Olympics marked the first time professional players could participate.

gods and goddesses living too close to their worshippers. For these reasons they began to believe in an imaginary Mount Olympus that was far away in the sky.

Greek poets did much to help this new idea. Homer holds to the first idea in the *Iliad,* but in the *Odyssey* he places the deities on a far-off mountain. No one knew where the new Olympus was.

See also **Mountain** (picture chart).

Omagh (pop. 45,568) is a local government district in Northern Ireland, centred on the town of Omagh, about 100 kilometres west of Belfast. The district contains several small market towns, such as Fintona and Sixmilecross, and depends on mixed farming. The area is dominated by the Sperrin mountains and attracts many tourists.

Omaha (pop. 335,795; met. area pop. 535,634) is the largest city in Nebraska. It ranks as one of the world's leading cattle market and meat-processing centres.

Omaha has about 600 manufacturing plants. Food processing ranks as the city's most important industry, and meat packing is the leading activity. The city is one of the chief frozen food producers in the United States.

O'Malley, Desmond (1939-), was the founder and first leader of the Progressive Democrats, a political party in the Republic of Ireland. O'Malley had been a member of Fianna Fáil, but was expelled in 1985 after speaking against the party line in a debate on family planning. He formed the Progressive Democrats early the following year. In 1989, the Progressive Democrats and Fianna Fáil formed a coalition government, and O'Malley became minister for industry and commerce.

Desmond Joseph O'Malley was born and educated at Limerick. In 1962, he became a solicitor. He entered *Dáil Éireann* in 1968. He held several positions in Fianna Fáil governments. He was minister for justice from 1970 to 1973, minister for industry from 1977 to 1981, and minister for trade, commerce, and tourism in 1982.

O'Malley, Grace, was an Irish queen of the 1500's. From Clare Island on the west coast of Mayo, she ruled the nearby islands and the districts surrounding Clew Bay. Her fleet of ships raided the seaports garrisoned by the English. Grace often directed her forces to attack other Irish chieftains. Legends based on the exploits of Grace O'Malley survive in many parts of western Ireland.

O'Malley, King (1854-1953), a member of the Australian Labor Party, served in the House of Representatives from 1906 to 1917. His main achievements were the establishment of the Commonwealth Bank, the construction of the transcontinental railway linking Kalgoorlie and Port Augusta, the setting up of Australia House in London, and the founding of Canberra. He was born in Canada. He emigrated to Queensland in 1889 because he suffered from tuberculosis. After he was cured, he walked from Rockhampton to Adelaide. He later moved to Tasmania.

Oman is a small country in the southeast corner of the Arabian Peninsula. Most of Oman is desert. But the land yields petroleum, which provides most of the country's income. The Gulf of Oman and the Arabian Sea border eastern Oman. They provide the country with an outlet to the world's oceans. The strategic Strait of Hormuz—through which much of the world's petroleum is shipped—lies at the northern tip of Oman. Oman is one of the hottest countries in the world. Temperatures often reach 54 °C.

Oman was an extremely poor country until oil was discovered there in 1964. Most of the people still struggle to make a living. But oil exports now finance many economic improvements. Muscat is the capital of Oman. Matrah is the largest city. Almost all Omanis are Muslims. About 75 per cent of the Muslims practise Ibadi Islam, a strict form of Islam.

Government. Oman is ruled by a monarch called a *sultan*. The sultan appoints 25 cabinet members who carry out the operations of the government. Some of the cabinet members are princes of the sultan's ruling family. A 55-member Consultative Assembly appointed by the sultan advises the government. Oman has no constitution and no legal political parties. The sultan appoints a *wali* (governor) to head each of the country's 41 *wilayot* (provinces).

Oman's court system includes the Chief Court and numerous local courts. All judges have Islamic religious training and base their decisions on Islamic law.

Facts in brief about Oman

Capital: Muscat.

Official language: Arabic.

Official name: Saltanat Uman (Sultanate of Oman).

Area: 212,457 km². *Greatest distances*—north-south, 805 km; east-west, 644 km. *Coastline*—about 1,700 km.

Elevation: *Highest*—Jabal Ash Sham, 3,035 m above sea level. *Lowest*—sea level.

Population: *Estimated 1996 population*—2,239,000; density, 11 people per km²; distribution, 87 per cent rural, 13 per cent urban. No census ever taken. *Estimated 2001 population*—2,656,000.

Chief products: *Agriculture*—alfalfa, bananas, coconuts, dates, limes, onions, pomegranates, tobacco, tomatoes, wheat. *Fishing industry*—sardines, cod, sharks. *Mining*—petroleum, natural gas, copper, chromite.

National anthem: "Nashid as-Salaam as-Sultani" ("Sultan's National Anthem").

Flag: The flag has a vertical red stripe and three horizontal stripes of white, red, and green. The national emblem, which features crossed swords and a dagger, appears in white at the top of the vertical stripe. See **Flag** (picture: Flags of Asia and the Pacific).

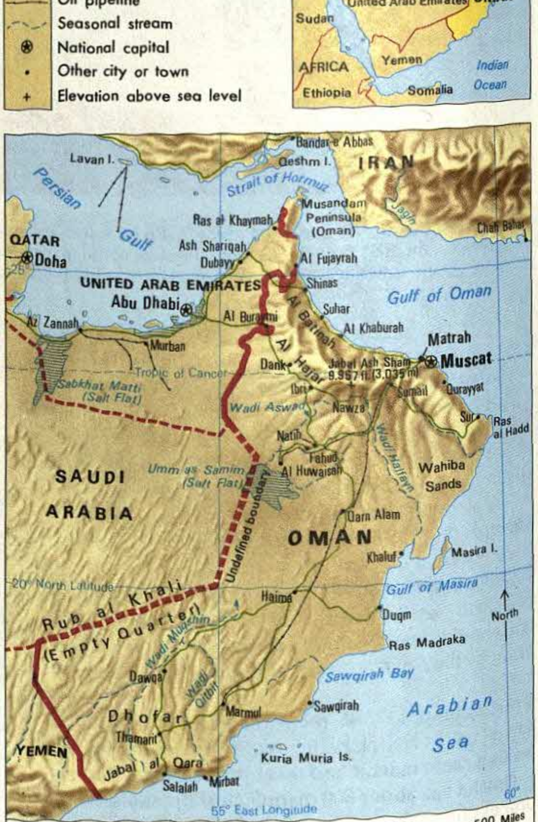
Money: *Currency unit*—Omani rial, or riyal. One rial = 1,000 baizas.

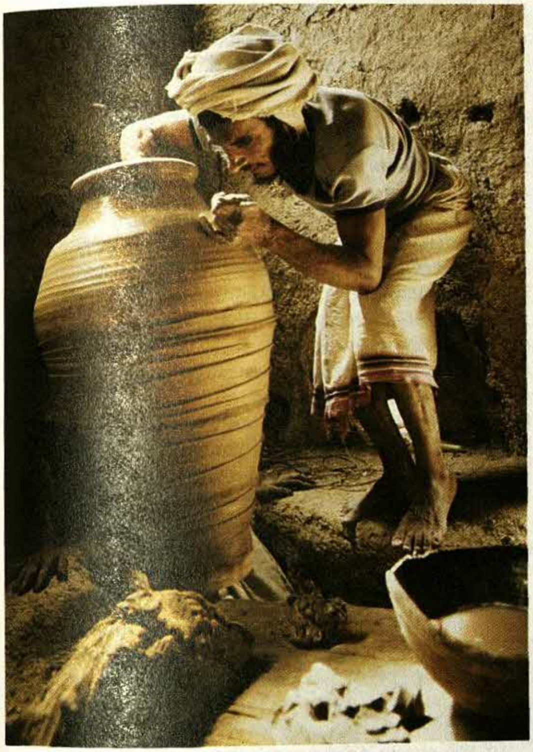
People. For Oman's total population, see the *Facts in brief* table with this article. The country's population is growing rapidly. About 90 per cent of the people are Arabs. The population also includes East Africans, Indians, Iranians, and Pakistanis. About 90 per cent of the people live in rural areas, and about 10 per cent of the people live in urban areas.

Most of Oman's rural people live in villages. On the coast, most people earn their living by working on date palm plantations or by fishing. In the interior, village farmers grow dates, fruit, and grain. Newer houses in Oman are made of concrete blocks. Older houses in coastal villages are constructed of wood and palm thatch. Older houses in interior villages include flat-roofed structures that have mud and stone walls. Large stone fortresses dating from the Middle Ages still dominate many villages. Nomads also live in rural areas. They wander from place to place and live in tents. Most nomads rear camels, goats, horses, and sheep.

Omanis depend heavily on wells for their water. Some of the wells receive their water from underground canals that were built in ancient times. These canals are called *aflaj* (singular, *falaj*).

Oman





An Omani craftsman uses a potter's wheel to make pottery. Like most Omani men, this potter wears loose, white garments and a turban for protection from Oman's strong sun.

The petroleum industry employs growing numbers of urban Omanis. Many city people work as government officials, labourers, merchants, or sailors. Oman's cities and towns have old, one- or two-storey whitewashed houses with enclosed courtyards. The largest cities have some modern, high-rise office buildings.

Most Omani men wear white robes and turbans to protect themselves from the blazing sun. Many of these men carry ornamental knives, called *khanjars,* in brightly coloured sashes. In rural areas of Oman, many men carry rifles. Most Omani women wear long, black outer dresses over colourful inner clothes. Some women wear black masks that cover most of the face. In Oman, as in other Islamic countries, the lives of most women are centred on household work and caring for children.

Arabic is Oman's official, and most widely used, language. Oman has a high illiteracy rate. However, since the 1970's, the government has built new schools for children, and has established adult literacy programmes. Sultan Qaboos University, the country's first university, opened in the Muscat area in 1986.

Land and climate. Oman covers 212,457 square kilometres. Most of the country is dry and rocky. The Musandam Peninsula in the north consists of barren mountains. It is separated from the rest of Oman by the United Arab Emirates. Al Batinah, a narrow coastal plain, lies along the Gulf of Oman. It is a fertile region where date palms thrive.

Steep, rugged mountains called Al Hajar separate the Batinah from the interior. The interior is a vast, flat wasteland. The Rub al Khali (Empty Quarter), a desert, covers western Oman. Most of Oman's coast along the Arabian Sea is barren and rocky. But tropical vegetation grows along the coast in Dhofar, a region in the south. Dhofar is famous for its frankincense trees, the best of which grow on a plateau north of the Jabal al Qara, a mountain range.

Temperatures in Oman may reach 54.4° C during the summer. Most of Oman receives less than 15 centimetres of rain each year. But Dhofar receives up 63.5 centimetres annually.

Economy. Oman has a developing economy. Oil exports account for most of its income. But most Omanis still rely on traditional jobs, such as farming and fishing, for a living. The chief crops include alfalfa, bananas, coconuts, dates, limes, onions, pomegranates, tobacco, tomatoes, and wheat. Many farmers in Dhofar rear cattle. Fishing crews in the Gulf of Oman and the Arabian Sea catch large amounts of fish, especially sardines. Oman's chief imports include oil-drilling and transportation equipment, machinery, and manufactured goods. Its main trading partners are Japan, the United Arab Emirates, Singapore, Australia, and Great Britain.

History. Arabs have lived in what is now Oman for thousands of years. In ancient times, Oman achieved great importance in the sea trade. Omani ships carried goods to and from lands along the Persian Gulf and the Indian Ocean. Most of Oman's people converted to Islam during the 600's. By the mid-700's, the Ibadi form of Islam had spread throughout much of Oman.

In 1507, Portuguese sailors captured Muscat and several other seaports in Oman. But local Arabs forced the Portuguese out of Oman in 1650. Oman gradually took over much of the east coast of Africa and established trading posts there. The Al Bu Said family, based in Muscat, came to power in the 1740's and has ruled Oman since then. Soon after the family began ruling Oman, the country became known as Muscat and Oman. The name was changed back to Oman in 1970.

In 1798, Oman signed the first of several treaties of friendship with Great Britain. Since then, the two countries have maintained close ties.

During the mid-1800's, Oman's old-fashioned sailing ships could not compete with the faster steam-powered

Barren wasteland covers much of Oman. In this wasteland, farmers struggle to earn a living by grazing cattle or other livestock. Life in rural Oman has changed little through the years.

ships then coming into use. As a result, Oman's sea trade declined, and the economy suffered. In 1861, Oman's east African territory became a separate state.

During the late 1800's and early 1900's, Ibadi Muslims in the interior tried to escape from the sultan's control. They wanted the imam of Oman, a religious leader, to govern them. The conflict broke out again in the 1950's. In 1959, British troops helped Sultan Said bin Taimur defeat the imam. In the 1960's, other groups began a revolt in Dhofar.

In 1970, Sultan Said bin Taimur—who was opposed to modernization—was overthrown by his son, Qaboos bin Said. As the new sultan, Qaboos introduced programmes to modernize Oman. He developed the oil industry and promoted the use of irrigation and other agricultural improvements. He built numerous roads, hospitals, and schools. Until 1970, few Omani girls attended school. Qaboos encouraged girls to attend school. Qaboos also won the Dhofar war.

In 1980, after the Soviet Union invaded Afghanistan, Qaboos agreed to allow the United States to improve Omani air and naval military bases. Under the terms of the agreement, the bases may be made available to U.S. forces during military emergencies. The work on the bases was completed in 1985.

In 1981, Oman and other states of eastern Arabia formed the Gulf Cooperation Council. The council members work together in such matters as defence and economic projects.

See also **Muscat.**

Oman, Sir Charles (1860-1946), was a British historian noted for his military histories. His best-known work is the seven-volume *History of the Peninsular War, 1807-1814* (1902-1930). His other works include *History of the Art of War in the Middle Ages* (1898), *A Short History of England* (1895), and a volume of memoirs, *Things I Have Seen* (1933). Oman was born at Muzaffarpore, in India, and named Charles William Chadwick Oman. He was educated at Winchester College and Oxford University. He was elected a member of Parliament in 1919.

Omar. See **Omar ibn al-Khattab.**

Omar ibn al-Khattab (586?-644) was the second *caliph* (successor to Muhammad as leader of the Muslim community) after the death of the Prophet Muhammad in 632. Omar was the first to assume the title of *commander of the faithful.*

Omar was born in Mecca, in Saudi Arabia, and was a member of the Prophet's own tribe, Quraysh. At first, he opposed the new religion but he was converted to it in about 615. He accompanied the Prophet into exile at Medina and became one of his closest advisers. In 625, Muhammad married Omar's daughter Hafsa. After the Prophet's death, Omar helped Abu Bakr become caliph and was chosen by him as his successor. In 634, Omar became caliph and presided over a massive and systematic expansion of the Islamic empire.

See also **Muslims** (The first caliphs).

Omar Khayyam (1048-1131) was a Persian poet, astronomer, and mathematician. He was famous during his lifetime for his reform of the Islamic calendar. About 100 years after his death, collections of poems appeared bearing his name. These poems express religious scepticism and a rather world-weary *hedonism* (love of pleasure). The verses show a mind acutely conscious of human ignorance and of the brevity of life. A collection called the *Rubaiyat* first attracted attention in the West in 1859, when English writer Edward FitzGerald published his free translation of a number of the stanzas arranged as a continuous poem.

Omar Khayyam was born in Nishapur, in what is now northwestern Iran. His name, which probably reflects an ancestor's trade, means *the tentmaker.*

See also **Rubaiyat; Fitzgerald, Edward.**

Omayyad. See **Muslims** (The spread of Islam).

Ombudsman refers in the United Kingdom to a public official more correctly called the *parliamentary commissioner for administration.* The commissioner, appointed by the government, hears complaints by individuals, through a member of Parliament, against government departments and other public organizations.

Omdurman (pop. 526,827) is the largest city in Sudan. It is on the west bank of the Nile, across the river from Khartoum, the capital. For location, see **Sudan** (map).

Omdurman is an important regional market. It is also a religious and cultural centre for Sudanese Muslims. The tomb of Muhammad Ahmed, a Muslim leader called the *Mahdi* (divinely appointed guide), stands in the centre of the city. Muhammad Ahmed founded the city in 1885. Near the tomb is a large market area called the *suq.* Many people who work in Khartoum live in Omdurman. Omdurman has modern flats and houses. It also has small houses made of sun-dried mud brick. Tents and shacks on the outskirts of the city provide shelter for many refugees from western and southern Sudan and from neighbouring countries.

Omega. See **Navigation** (Omega).

Omen is supposedly a sign of future good or bad luck. A good omen foretells a desirable event, and a bad omen forecasts disaster. For example, a person may regard a dream about gold as an omen of success in business. Or the person may believe that the death of a relative will follow a dream about losing a tooth. Sometimes omens come from a deliberate attempt to look into the future, such as a fortuneteller's "reading" cards.

Many ancient societies believed that lightning, thunder, or the behaviour of animals foretold events. The Mesopotamians thought fire would destroy the king's palace if a dog were seen lying on the throne. In folklore, many heroes die after disregarding such signs.

See also **Augur; Divination; Superstition.**

Omm Kalthum (1910-1975), an Egyptian singer, became known as "the mother of Middle Eastern music."

Omm Kalthum was born in a poor village of the Nile Delta in Egypt. She received a traditional religious education. But while she was still a child, her teachers recognized that she had an outstanding musical talent. She moved to Cairo and changed from religious music to popular music. Omm Kalthum became famous as a teenager. By the time she was in her twenties, she was a nationally recognized figure in Egypt. She gave regular concerts and dazzled audiences with the range and power of her voice. Despite her wealth, she lived modestly. Omm Kalthum gave generously to the poor people of Egypt, the class into which she had been born. Her death was an occasion of national mourning and her funeral was of a kind given to the head of a country.

Ommatidium. See **Compound eye.**

Omnirange. See **Navigation** (Omnirange).

Omnivore is an animal that eats both animals and plants. The bear, the rat, and the red fox are examples of omnivores.

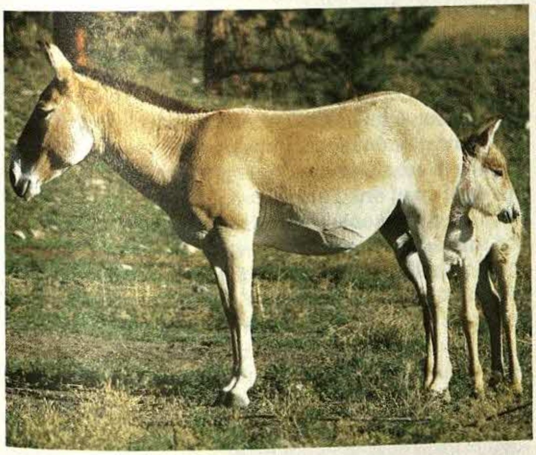
See also **Carnivore; Herbivore.**

Omsk (pop. 1,159,000) is an important manufacturing centre of Russia. Omsk lies along the Irtysh River in Siberia, about 2,190 kilometres east of Moscow. Omsk is one of the largest cities in Siberia. For location, see **Russia** (political map).

Omsk manufactures farm machinery for the surrounding agricultural area. The city also has large food-processing, oil-refining, and petrochemical industries.

Omsk was founded in 1716, during the Russian expansion into Siberia. The Trans-Siberian Railway reached the city in 1894, and Omsk became a commercial centre of western Siberia. During World War II (1939-1945), the government moved many factories from combat zones in the western part of the country to safe areas in Siberia. Omsk developed rapidly as a result, and its industries have continued to expand.

Onager is a fast-running relative of the donkey. It is the *wild ass* mentioned in the Bible, where a good description of it may be found (Job 39: 5-8).



Onagers resemble donkeys but run as swiftly as horses. The onager is reddish-brown in the summer and yellow-brown in the winter. This Persian onager stands with her foal.

The onager travels in herds on the hot, dry plains of west-central Asia. Its colour varies from reddish-brown in summer to yellow-brown in winter. A yellow patch covers each thigh and a broad black stripe runs along its back. The onager has a mane, and a tuft of hair at the end of its tail. It is about 1 metre high at the shoulders.

Scientific classification. The onager is in the horse family, Equidae. It is *Equus hemionus.*

Onassis, Aristotle Socrates (1906-1975), a Greek shipowner and business executive, became one of the world's wealthiest individuals. In 1968, he married Jacqueline Kennedy, the widow of U.S. President John F. Kennedy.

Onassis was born in Smyrna (now Izmir), Turkey, the son of a well-to-do tobacco importer. He emigrated to Argentina in 1923 after his father lost his fortune. In Buenos Aires, he became a telephone switchboard operator and later a tobacco importer. He entered the shipping business during the Great Depression of the 1930's and bought several freighters at an extremely low price. He was a shrewd, daring investor and ignored the advice of many shipping experts after World War II, when he built several giant oil tankers. This venture was highly successful. Onassis also owned Olympic Airways, the only Greek airline, from the mid-1950's until the government took it over in the mid-1970's.

Oncology is the study of the development, treatment, and prevention of cancer. It includes both research and clinical care. Doctors who specialize in oncology are called *oncologists.*

In the laboratory, oncologists compare human cancer cells with normal cells to try to understand the cellular mechanisms that control the growth of normal tissues. By understanding these mechanisms, oncologists hope to find ways to correct abnormal tissue growth. Similarly, cancers in animals are studied to learn how the body itself often controls the growth of cancer cells. For example, oncologists study how naturally occurring chemicals called *interleukins* stimulate an animal's immune system to eliminate cancer cells. Through such research on animals, oncologists hope to develop methods of prevention and treatment for people.

Clinical oncologists diagnose and treat cancer. A diagnosis is made by examining a piece of abnormal tissue under a microscope. This procedure, called a *biopsy,* determines whether the tumour is *malignant* (cancerous). Methods of treatment depend on whether tumours are limited to one site or organ in the body or whether cancer cells have spread to other organs. Surgery, radiation, drug therapy, or combinations of these treatments may be used (see **Cancer** [Cancer treatment]).

One-celled organism. See **Protista; Protozoan.**

One-crop farm. See **Agriculture.**

O'Neale, Peggy (1796-1879), was a central figure in one of the greatest society disputes in the history of Washington, D.C. The dispute caused U.S. President Andrew Jackson to reorganize his Cabinet.

Margaret O'Neale was born in Washington, D.C., the daughter of an innkeeper. Margaret, known by the nickname Peggy, married John B. Timberlake, a navy purser. She lived at the O'Neale tavern while Timberlake was at sea. Senator John H. Eaton of Tennessee lived there in 1818, and became fond of Peggy. Andrew Jackson, who became a U.S. senator from Tennessee in 1823, met Peggy at the inn. Peggy's husband died in 1828, and she married Senator Eaton on Jan. 1, 1829.

Eaton became secretary of war in 1829. Washington society refused to receive Peggy, because of her father's occupation and because of gossip about her conduct with Eaton. President Jackson stood by her, despite his family's protests. Several Cabinet members resigned, and Eaton resigned his post in 1831.

Onega, Lake. See **Lake Onega.**

O'Neill, Lord (1914-1990), Baron O'Neill of the Maine, was prime minister of Northern Ireland from 1963 to 1969. He resigned after his party refused to support conciliation with Northern Ireland's Roman Catholic minority. Terence Marne O'Neill was born in London, and educated at Eton College. From 1939 to 1945, he served with the Irish Guards and became a captain. In 1946, he was elected member of Parliament for Bannside, in Antrim. In 1956, he became minister for home affairs. From 1956 to 1963, he was minister of finance.

O'Neill, Eugene Gladstone (1888-1953), is considered America's greatest playwright. He was the first American dramatist to write tragedy consistently. Before O'Neill, most successful American plays tended to be either melodramas or sentimental comedies. O'Neill won the Nobel Prize for literature in 1936. Four of his plays won Pulitzer Prizes—*Beyond the Horizon* in 1920; *Anna Christie* in 1922; *Strange Interlude* in 1928; and *Long Day's Journey into Night* in 1957.

Eugene O'Neill

O'Neill was born in New York City. He was the son of James O'Neill, a well-known actor. Eugene O'Neill attended Princeton University briefly in 1906, and then left college and took a variety of jobs. As a seaman, O'Neill sailed to South Africa and South America in 1910 and 1911. Many of O'Neill's plays reflect his experiences at sea. Others show his sympathy for the failures and outcasts of society that he met during this time.

O'Neill's 45 plays cover a wide range of styles and subjects. They vary in length from one act, to the nine-act *Strange Interlude* (1928) and the 11-act *Mourning Becomes Electra* (1931). O'Neill wrote brutally realistic plays, including *Desire Under the Elms* (1924); expressionistic plays, including *The Hairy Ape* (1922); satire, including *Marco Millions* (1928); and autobiographical plays, including *Long Day's Journey into Night* (1956).

O'Neill stated that his task as a playwright was to "dig at the roots of the sickness of today." He believed that science had robbed people of their faith in traditional beliefs and had not given them a new faith. O'Neill's pessimistic view of life was influenced by the writings of German philosophers Friedrich Nietzsche and Arthur Schopenhauer and Swedish playwright August Strindberg. Modern psychology also influenced O'Neill. In *The Great God Brown* (1926), his characters wear masks to express their personalities. The characters in *Strange Interlude* speak their thoughts aloud, exposing their inner feelings. In *Days Without End* (1934), two actors portray different parts of a character's personality.

Most of O'Neill's characters seek some meaning for their lives. In *Beyond the Horizon* (1920), *Anna Christie* (1921), and *Strange Interlude,* the characters turn to love to find meaning. In *Dynamo* (1929) and *Days Without End,* they turn to religion. All suffer disappointment. In *The Iceman Cometh* (1939), O'Neill's most pessimistic play, the characters in a waterfront saloon have ruined their lives. But they find meaning in their illusions about themselves. When these illusions are taken from them, they come close to despair. O'Neill says that all illusions are "pipe dreams." He seems to assert that humanity's only "hopeless hope" is in drink and death. But he also seems to say there is an admirable heroism in people who persist in living without hope.

See also **American literature** (The rise of American drama); **Naturalism** (Naturalism in drama).

O'Neill, Owen Roe (1590?-1649), was an Irish patriot and soldier. He commanded Irish forces in an uprising against the English in the 1640's.

In 1641, the Irish rebelled against local English colonists. At first, the Irish forces were victorious, but they were badly defeated at the Battle of Glenmaquin in 1642. Soon afterwards, O'Neill arrived in Ireland with arms and 200 veteran soldiers. He drilled and trained the Irish forces and routed a combined English and Scottish army at the Battle of Benburb in 1646. However, quarrels and disputes among the Irish leaders ruined O'Neill's efforts to follow up his advantage. Such problems also prevented O'Neill from freeing all of Ireland from English domination.

O'Neill was born in Ulster, but he left Ireland at the age of 16. He joined the Spanish army and rose to the rank of colonel.

Onion is a vegetable that has a strong odour and flavour. Onions rank as one of the world's most popular foods. They are used chiefly as a seasoning and are eaten raw, cooked, dehydrated, and pickled. When cut, raw onions give off a vapour that causes people's eyes to water.

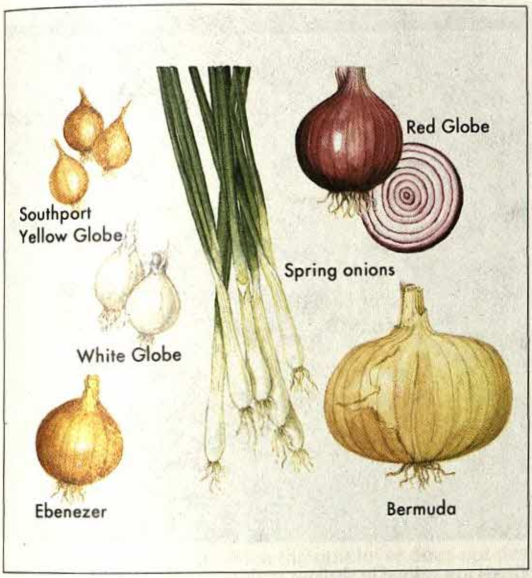
The onion plant. Most onion plants are *biennials* (plants that require two years to complete their life cycle). When fully grown, they consist of leaves, a bulb, and roots. The long, slender leaves are hollow cylinders that grow upright. They thicken at the base to form a bulb, the part of the plant that people eat most frequently. Onion bulbs grow partially above ground. They tend to be globe-shaped, but some are wide and flat and others are slender and upright. A thin papery covering made up of dried outer leaves encloses the onion bulb. The typical onion smell is due to the substance allyl sulphide.

Onion bulbs may be red, white, or yellow. A cluster of short root fibres grows from the bottom of the bulb. During its second year of growth, an onion plant produces rounded clusters of small, greenish-white, seed-bearing flowers at the tips of its flower stalks. Most onions are harvested during the first year and thus do not produce flowers.

Four main groups of onions are grown. They include (1) a main crop sown in the spring, harvested in the autumn, and stored for winter use; (2) a summer crop grown from an autumn sowing or from *sets* (young dried onion bulbs) planted in the spring; (3) *salad* or *spring onions* sown in the spring or autumn, and pulled when they are green; (4) pickling onions—small, quick-growing bulbs that are sown in the spring and picked in the summer. To form bulbs, onions require a minimum temperature of 16° C.

Cultivation. Onion growers plant onion sets, seeds, or seedlings. Seedlings are grown in a greenhouse or in areas that have a warm climate during winter. Seeds are planted at a depth of about 1.5 centimetres. Sets are pressed into the ground but left uncovered. Onions require a light, rich soil. They also need plenty of water, especially when they are young. When the bulb is ready to be harvested, the plant's leaves become limp and fall over. To avoid decay, growers dry and store harvested bulbs in a cool place.

Onions differ in the strength of their flavour. People use such strong-tasting onions as the Yellow Globe in



The onion is a vegetable with a bulb that can be eaten raw or used in cooking. Onions come in many shapes, sizes, and colours. This illustration shows some common kinds of onions.

soups and stews. Mild onions, including the Sweet Spanish, are often eaten raw in salads or in sandwiches.

Onions in the diet stimulate the flow of digestive juices and aid digestion. Onion sap kills bacteria and can be used to heal wounds. The outer scales of onions were used to dye cloth.

Onions probably first grew in central or southwestern Asia. Today, they are grown throughout the world.

Scientific classification. Some botanists classify the onion in the amaryllis family, Amaryllidaceae. Others place it in the lily family, Liliaceae. The onion is *Allium cepa*.

See also **Garlic; Ramp.**

Most onion bulbs are globe-shaped. The bulbs grow partly above ground. Onions need rich soil and plenty of water.

Onn bin Ja'afar, Dato (1895-1962), was the most outstanding political and administrative figure in Malaya before the country gained its independence from British rule in 1957. In 1946 he founded United Malays National Organization (UMNO) as a political party. He worked in opposition to the British colonial government, and in 1948 was successful in achieving the formation of the Federation of Malaya. In 1951, Onn bin Ja'afar resigned from UMNO because of policy differences within the party. He formed *Parti Negara* (National Party), which opened its membership to all races in Malaya and campaigned for cooperation among races. Onn bin Ja'afar lost the election in 1955, two years before Malaya gained its independence. But historians agree that he played an important part in the independence movement of his country.

Onn bin Ja'afar was born in Johor Bahru. He was educated in Johor Bahru, at the Malay College in Kuala Kangsar, and in the United Kingdom. He joined the Johor administration, then turned to journalism in the 1930's, becoming editor of *Warta Malaya,* the first independent Malay newspaper. Later, he became chief minister of Johor.

See also **Malaysia, History of.**

Onslow, Arthur (1691-1768), was speaker of the British House of Commons from 1728 to 1761 (see **Parliament**). During his 33 years in this office, the longest period so far recorded, Onslow helped to promote the speaker's status as an independent guardian of the rights of members of the House of Commons. Onslow was born in Chelsea, London. He was member of Parliament for Guildford and later for Surrey. He became treasurer of the Navy in 1734, but resigned in 1742 in order to counter charges of self-interest.

Ontario (pop 10,084,885) is a Canadian province. About a third of Canada's people live in Ontario. Service industries provide Ontario with its greatest source of income. Ontario's manufacturing industries produce about as much as those of the nine other provinces combined. Ontario ranks first among the Canadian provinces in farm income and second only to Alberta in mining. Toronto is the capital of the province, and the Toronto area is Canada's leading manufacturing centre. Ottawa, the capital of Canada, lies on the Ottawa River in southeastern Ontario.

Ontario, Lake. See **Lake Ontario.**

Ontology. See **Philosophy** (Metaphysics).

Onyx is a term used loosely to apply to a banded carbonate rock and also to agate, a fine-grained variety of quartz (see **Agate**).

Ordinary onyx of quartz is black and white, green and white, or red and white, and so on. *Sardonyx* is brown and white onyx. Onyx is hard and takes a high polish. It is widely used in the carving of cameos and intaglios. Today, jewellers refer to single-colour agate as *onyx.* When they speak simply of onyx, they mean the black stone.

Onyx marble (Mexican onyx) is a variety of calcite rock found on the walls of caves. Mexican onyx shows a banding like that of agate, but it is much coarser. The colours of Mexican onyx range from white to green, red, and brown. Much of this soft onyx marble is cut into gemstones, coloured with an aniline dye, then set in inexpensive native silver jewellery. The stones are brittle and not durable. Mexican onyx is also used as a decorative stone.

See also **Cameo; Gem** (picture); **Sardonyx.**

Oostende. See **Ostend.**

Ooze is a name for the mud found on the bottom of the ocean in deep waters. One variety of this mud consists of red clay and occurs extensively on the bottom of the Pacific Ocean. Another variety is made up mostly of shells and skeletons of tiny sea organisms called *foraminifera, radiolaria,* and *diatoms.* All three are termed *plankton,* which is the name for forms of life that float in the water. The foraminifera make their shells from calcium carbonate that is contained in solution in the seawater. A type of limestone called *nummulitic limestone* is made up mostly of the shells. The hard parts of the radiolaria and diatoms usually contain silicon.

The term ooze is also used for any mud, either on the surface of the earth, or in the beds of rivers, streams, ponds, or lakes.

Opal is a gemstone that contains a rainbow of colours. It is made up of silicon and oxygen, the elements found in common sand. The background colours of an opal may be black, blue, brown, grey, or white. Opals show brilliant colours when turned in a bright light.

The most prized opals are called *black* opals. These opals have a black, blue, or grey background. Black opals of high quality are found in New South Wales, Australia.

Opals are unique among gemstones because of their unusual internal structure. This structure consists of numerous tiny spheres of silica that are packed together in a regular pattern to form layers. The *refraction* (bending) of light between these layers causes the light to break up into the colours of the rainbow, thus producing the gemstone's extraordinary flashes of colour. Opals may be found in irregular patches, often filling cavities and cracks in rocks.

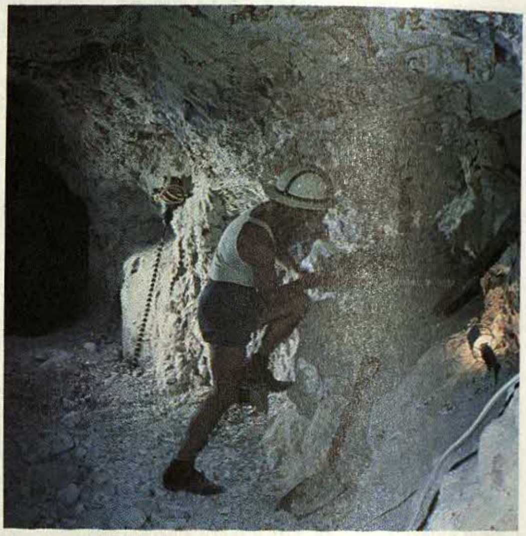
In some opals, the water dries up and the opal becomes covered with tiny cracks. This process is called *crazing,* and it detracts from the value of the stone. Opals also are not as hard as most gems, and they may easily be scratched or chipped.

There are many different kinds of opals. Opals that display brilliant colour flashes are *precious* opals. Most precious opals are mined in Australia. Mexico is known for its *water* opals and *fire* opals. Water opals are colourless and transparent and give off bright flashes of colour. Fire opals are cherry-red, and most of them do not give off colour flashes. The fire opal is a variety of *common* opal. Common opals do not show colour flashes and are usually not considered gem material.

White opal

Because the beauty of opals lies in their internal colour flashes, they are rarely cut with facets as diamonds are. Instead, they are cut with a gently rounded surface. This style of cutting gemstones is called *cabochon* cutting.

Opal mining is not an organized industry and does not lend itself to mechanization. Although opals attract high prices, profits are not sufficient to attract large investors. Most *gougers* (opal miners) work in pairs. They sink a shaft to the opal seam. Then, taking care not to damage the opal, the gougers follow the seam by scratching around with a pick and filling buckets with earth. In some areas, the overburden is removed to form an open-cast mine.



Opals are mined in shallow, underground mines. Miners work singly, *above,* or in pairs with few mechanical aids.

Australia produces about 95 per cent of the world's opal. The opal is polished and used for jewellery.

Coober Pedy, about 700 kilometres northwest of Adelaide, South Australia, produces most of the world's opals. Production at other fields declined in the 1970's, but new fields were opened in the early 1980's.

Large opals of the world include a Hungarian opal that weighs 594 grams, now in the Museum of Natural History in Vienna. The *Roebling* opal, which was found in Nevada, is the most beautiful American opal. It is almost pitch black, with colour flashes of great brilliancy. It weighs 530 grams and is on display at the National Museum of Natural History in Washington, D.C. The huge *Desert Flame of Andamooka* opal weighed over 6,800 grams when found in Australia in 1969. The opal is one of the birthstones for October.

Oparin, Alexander Ivanovich (1894-1980), was a Soviet biochemist. He developed a theory that explains how life on earth originated from chemical substances. His ideas became the basis of many modern scientific theories of the origin of life. Oparin also did much research on the biochemistry of converting raw agricultural crops into such products as bread, sugar, tea, tobacco, and wine.

Oparin's theory of the origin of life rested on his belief that the earth's early atmosphere contained mostly ammonia, hydrogen, methane, and water vapour—not nitrogen and oxygen as it does today. He suggested that the chemical molecules necessary for life formed spontaneously in such an atmosphere. These molecules combined and formed more complex molecules. These complex molecules formed still larger combinations, and finally they developed into the first living cells through hundreds of millions of years.

Oparin was born near Moscow. He graduated from Moscow State University in 1917. He first published his theory in 1923 and expanded it in a book called *The Origin of Life* (1936). In 1946, Oparin was appointed director of the Bakh Institute of Biochemistry in Moscow.

OPEC. See **Organization of Petroleum Exporting Countries.**

Open-cast mine. See **Iron and steel** (Open-cast mining); **Mining** (Kinds of mining; picture).

Open city. See **International law** (The laws of war).

Open-hearth furnace. See **Iron and steel** (The open-hearth process).

Open shop is a business that employs both union and nonunion workers. It is the opposite of a *closed shop,* where only union members may be employed. In one use of the term, a union may represent the workers in an open shop if a majority of them belong to the union. But no one must be required to belong to the union in order to be hired by the company. The term may also refer to a company in which the employer does not deal with a union.

See also **Closed shop.**

Open University is the name of several national organizations that offer degree, diploma, vocational, professional, and other adult education courses to adults who study at home or at work. This method of studying involves two processes, called *open learning* and *distance learning.* Distance learning is also called *distance education* or *tele-learning.*

Open learning is the process by which students receive education or training with little or no formal classroom work. The term also often implies that students require no prior qualifications to take the course. Students work mostly alone or in small informal groups. They use specially written textbooks and electronic resources such as computer software.

Distance learning is a method of study for students who are far away from teachers. Students at home or in their place of work may receive tuition or training through television or radio broadcasts, and video or audio tapes. Distance learning involves open learning because these broadcast sessions are usually supported by books and other materials. Students may also use telephone-linked computer networks to consult computer databases hundreds or even thousands of kilometres away.

The United Kingdom Open University. The model for most of the world's distance-learning institutions is the United Kingdom Open University (UKOU). Set up by royal charter in 1969, the UKOU admitted its first students in 1971. The UKOU is an independent university that offers many different distance-learning programmes, mainly to home-based students in the UK.

Central to each course provided by the UKOU is a set of its own textbooks called *units.* The units are linked to television and radio programmes and other resources. In addition, the UKOU operates a counselling system in which locally based tutors can give help and guidance. The students can meet their tutors and fellow students at local study centres or at residential weekend and summer schools.

Most UKOU students study *undergraduate programmes* that lead to a Bachelor of Arts (BA) or Bachelor of Science (BSc) degree. The UKOU offers more than 130 courses at *foundation* (preparatory), second, third, or fourth level and in six fields of study—arts, education, mathematics, science, social science, and technology. Students work toward their degree by following a number of one-year courses. Students who pass each course earn a *credit* or *half-credit.* Students' work is assessed on written exercises submitted during each course and on examinations taken at the end of each year. A minimum of six credits is normally required for a BA or BSc. Undergraduate courses are also open to students not wishing to take a degree.

Students may study either full-time or part-time for *postgraduate courses* and *research degrees.* Such courses lead to masters' degrees or doctorates of philosophy.

Management training programmes are offered by the Open Business School (OBS) of the UKOU. Available training programmes range from short courses for newly promoted managers to long study courses leading to the degree of Master of Business Administration (MBA). The UKOU has set up similar programmes in other European countries. In addition to management training, the UKOU also offers professional and leisure-interest courses.

Other institutions follow a similar pattern to that of the UKOU. Some of them, such as the University of the South Pacific and the University of the West Indies, which cross several country boundaries, employ satellite television to broadcast to students.

In Singapore, the Open University Degree Programme (OUDP) began in 1994 at the Ngee Ann Polytechnic. The OUDP, operated by the polytechnic and the UKOU, offers degrees that are recognized by the Singapore Public Service Commission.

Distance-learning programmes in India date back to 1962, with the opening of the correspondence institute of the University of Delhi. One in five of all India's universities have correspondence institutes. Since the 1980's, the limited scope of the courses offered by these correspondence institutes has been broadened by the opening of the Andhra Pradesh Open University in 1982 and the Indira Gandhi National Open University in 1985.

In Hong Kong, the Open College of the University of East Asia teaches through distance-learning courses imported from institutions in other countries. Japan's University of the Air opened in 1985 and offers four-year courses to both adults and school graduates. Other countries with institutions offering distance-learning courses are China, Pakistan, South Korea, Sri Lanka, and Thailand.

In Australia, the University of Southern Queensland's Distance Education Centre offers degree courses in computer science, education, languages, law, and the sciences. Deakin University, at Burwood, Victoria, provides a Bachelor of Education degree through distance learning. In New Zealand, Massey University in Palmerston North and the University of Otago in Dunedin supply distance-learning university-level courses. The University of Otago has created a national teleconferencing network to be used for programmes in continuing medical education, dentistry, the humanities, social work, and wildlife management.

Elaborate scenery and colourful crowd scenes add excitement to many operas. The spectacular "Triumphal March" shown above takes place in Act II of Giuseppe Verdi's tragic opera *Aida.*

Opera

Opera is a drama in which the characters sing, rather than speak, all or most of their lines. The story line is frequently extremely dramatic, portraying deep and timeless feelings common to all mankind. In a number of the most famous operas, the tragic element can be very strong. Opera is perhaps the most complex of all art forms. It combines acting, singing, orchestral music, costumes, scenery, and often ballet or some other form of dance.

In telling a story, opera uses the enormous power of music to communicate feeling. Music can often express emotions better than spoken words can. Singers, accompanied by an orchestra, may bring a dramatic situation to life more vividly than actors with spoken dialogue. Vocal and orchestral music can also tell an audience much about a character and his or her state of mind.

Most opera composers base their works on highly emotional stories because music has the power to express all kinds of emotion so well. An opera, more than a spoken play, is likely to emphasize passionate scenes of anger, cruelty, jealousy, joy, love, revenge, sadness, or triumph. Music can also add excitement and give a heightened dramatic impact to scenes portraying spectacle. Some of the most stirring music in opera accompanies colourful crowd scenes, such as a coronation or a military parade.

Opera differs in several ways from other kinds of plays that have music. For example, William Shakespeare's comedy *A Midsummer Night's Dream* has scenes that call for music. Such music is called *incidental music* because the play is dramatically complete without it. Incidental music written by different composers may be used in different productions. The German composer Felix Mendelssohn wrote incidental music for *A Midsummer Night's Dream* that has become very popular.

Musical comedies and operettas resemble opera, but most of them have much more spoken dialogue than an opera has and their music is lighter. Compositions called *oratorios* also share certain features with opera. Like an opera, an oratorio has music for soloists, chorus, and orchestra. It may also tell a story. But unlike operas, almost all oratorios are intended to be performed in a concert hall and without acting, costumes, or scenery.

Organizations called opera companies produce most operas. Most companies are *repertory theatres*—that is, they present several operas alternately during a season. The operas a company presents are called its *repertoire.*

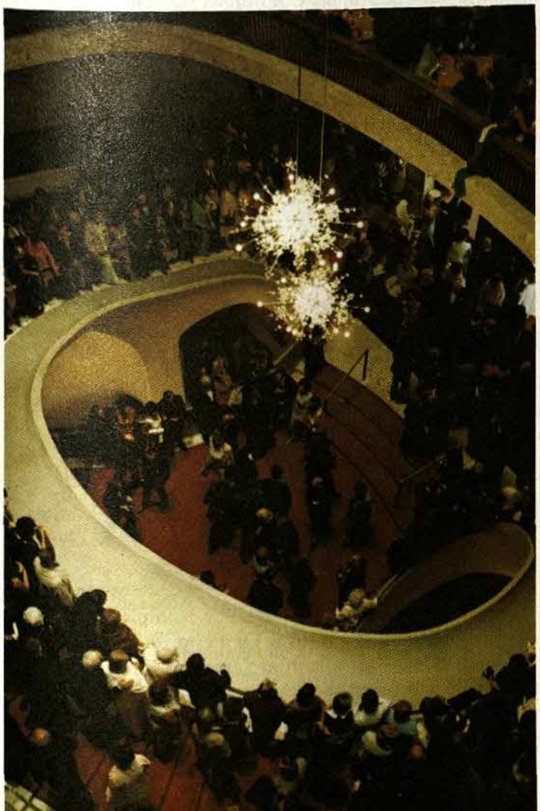
Most operas call for a large orchestra and a large cast of performers. As a result, operas are usually performed in specially designed theatres called *opera houses.* Most opera houses seat many more people than do theatres reserved for spoken drama. An opera house also has special facilities and equipment to provide the elaborate staging required by many operas. All modern opera houses have an orchestra pit between the stage and the seats of the auditorium. From the pit, the orchestra, directed by the conductor, accompanies the singers onstage.

Most opera houses built in the 1700's and 1800's, and some modern ones, have rows of boxes arranged in the auditorium. Originally, the boxes were reserved for the nobility who patronized the opera and for their families and guests. Because it is difficult to get a good view of the stage from many box seats, modern opera houses rarely feature this arrangement.

Opera, as we know it today, began in Italy in the late 1500's. Through the years, Italian composers, singers, and conductors have played a leading role in the history and development of opera. By the end of the 1600's, opera had spread from Italy to other European countries. Today, opera can be enjoyed in many parts of the world.

Among the world's best-known companies are those that perform at the Teatro alla Scala (La Scala) in Milan, Italy; the Paris Opéra; The Royal Opera House, Covent Garden, in London; the State Opera in Vienna; the Festival Playhouse in Bayreuth, Germany; and the Metropolitan Opera House in New York City. Other leading opera houses are the Sydney Opera House, and the London Coliseum, home of English National Opera.

Opening night at the opera ranks as one of the most glamorous social events of the year. The opening night crowd below mingles in the lobby of an opera house.



Terms used in opera

Aria is an elaborate vocal solo that usually expresses a character's feelings.

Bel canto refers to a style of singing that emphasizes beautiful tone and technical skill.

Coloratura is a flowery, ornamental vocal style generally used by extremely high soprano voices.

Ensemble is a small group of singers, usually from two to five. The music the group sings is also called an *ensemble.*

Grand opera refers to operas of the early 1800's that emphasized spectacular stage effects, big crowd scenes, and complicated, elaborate vocal and instrumental music. The term *grand opera* also means an opera with no spoken dialogue.

Leitmotif is a short musical passage that identifies certain ideas, places, and characters each time they appear in the drama.

Libretto is the text of an opera.

Opera buffa is an Italian comic opera concerned with humorous situations that occur in everyday life.

Opera seria was the leading opera form of the 1600's and early 1700's. It dealt primarily with historical and mythological themes and stressed spectacular stage effects and displays of brilliant singing.

Recitative is the part of the text that provides information about the action and moves the plot forward. It is sung in a simple, speechlike style, sometimes to orchestral accompaniment. In *secco recitative,* the accompaniment is provided by only a harpsichord or a harpsichord and cello or other bass instrument.

Score is the written or printed music for an opera, used by the conductor.

Singspiel is a form of German opera, usually comic, that has spoken dialogue instead of recitative. Most of the songs are simple and folklike.

Verismo is a style of realistic Italian opera that focuses on violent actions and emotions.

The elements of opera

An opera has two basic elements: (1) the libretto and (2) the music. The libretto, which means *little book* in Italian, consists of the words, or text, of an opera. The music, which is also called the *score,* consists of both vocal and instrumental music. To translate the libretto and music into a performance, an opera must have singers, a conductor, and an orchestra.

In writing an opera, words and music are of equal importance. Composer and *librettist* (the author of the play) should be equal partners.

The libretto

To enjoy an opera fully, an operagoer should read the libretto or a summary of the action beforehand, especially if the opera is sung in an unfamiliar language. Some public libraries have librettos. Most libraries have books that contain summaries of the action in individual operas. Generally, an opera house provides a programme that has a summary of the plot.

The libretto of most operas is shorter than the text of a spoken play because it takes longer to sing a given number of words than to speak them. Librettos may also be shorter than the script of a spoken play because a few measures of music can often express emotions more vividly than many lines of spoken dialogue can. Because a libretto has to be relatively short, the story of an opera is likely to be simpler than that of a spoken play, with fewer characters and fewer secondary plots.

Many operas have been criticized for their poor librettos. Such operas give the impression that the composer used the text merely as a framework for the music. Yet flimsy plots and shallow characters do not bother many people. They attend the opera mainly to hear beautiful music sung by beautiful voices. Other people feel that a good opera must also be a good drama. And in fact, some librettos are outstanding works of literature. These librettos include those that the Austrian poet Hugo von Hofmannsthal wrote for the operas of Richard Strauss.

Many librettos seem dated today because the definition of good drama in opera has changed over the years. Numerous subjects that were popular in operas of the 1600's, 1700's, or 1800's are now out of fashion. Yet modern operagoers can still enjoy these older operas if they learn something about the customs in drama and music that influenced their composition.

Recitative and arias. Certain parts of the libretto simply provide information for the audience. For example, one character may tell another about something that has happened. In some operas, the characters speak these portions of the text. But in many operas, the characters sing them in a simple, speechlike style called *recitative.* Most recitatives are written in everyday language—that is, they do not rhyme. Recitatives were especially popular in operas of the 1700's and early 1800's.

The most emotional parts of the libretto are solo numbers called *arias.* They usually express a character's feelings or thoughts. Most arias are written in rhythmical, rhymed verse. They are also set to far more elaborate music than are recitatives. In fact, arias provide the most beautiful and dramatic music in many operas.

Spoken dialogue or recitative carries the action forward. At intervals, the action stops and the characters sing arias to express their feelings. An example of the use of recitative and aria appears in the following passage from Wolfgang Amadeus Mozart's opera *Don Giovanni.* In the passage, a character sings several lines of recitative, ending with:

> Every means must be sought to
> discover the truth . . . I shall avenge her!

He then sings an aria that begins with these lines:

> My peace depends on hers; that which
> pleases her gives life to me. . . .

The recitative above tells the audience about the character's future actions. The aria expresses his state of mind. The original Italian text for this aria was written in rhymed poetry.

Ensembles. In many operas, the libretto calls for two or more singers to engage in a musical dialogue, called an *ensemble.* The singers themselves are also called an *ensemble.* The most common ensembles are duets, trios, quartets, and quintets.

A special kind of ensemble requires several characters to sing at the same time and express their thoughts and feelings. They may sing the same words, showing agreement. Or they may sing different words and melodies, expressing conflicting feelings and thoughts.

An opera ensemble is a small group of singers. The music they sing is also called an *ensemble.* A countess, her daughter, and a soldier sing a lively, comic ensemble in this scene from Act II of *The Daughter of the Regiment* by Gaetano Donizetti.

The music

The singers. In an opera, each role calls for a singer with a specific voice range. Opera singers are therefore classified according to the range of their voices.

The basic vocal classifications for women, from highest to lowest range, are soprano, mezzo-soprano, and contralto. Each of these classifications can be divided into more specialized groups. For example, sopranos can be divided into coloratura sopranos, lyric sopranos, and dramatic sopranos. Coloratura sopranos have a very high range and can sing with great agility. Lyric sopranos have a light, graceful voice appropriate to youthful roles. Dramatic sopranos have a rich, strong voice suited to highly emotional parts.

The chief voice classifications for men, from highest to lowest range, are tenor, baritone, and bass. Each of these classifications can also be divided into more specialized groups. For example, tenors can be divided into lyric tenors and dramatic tenors. A lyric tenor has a light, high voice. A dramatic tenor, who is often called by the German word *Heldentenor,* has a rich, powerful voice with a lower range than a lyric tenor. Such voices are needed for the heroic roles in operas by Richard Wagner. Bass voices are classified as basso cantante, basso buffo, or basso profundo. A basso cantante has the highest bass voice, which has a range similar to that of a lyric tenor. A basso buffo has a deep, flexible voice and sings comic roles. A basso profundo has an especially low voice and usually sings majestic, serious roles.

Choral singing. Most operas include choral singing as well as arias, recitatives, and ensembles. The function and importance of the chorus vary from opera to opera and even within an opera. A chorus may provide only visual background for a scene. For example, it might portray a crowd at a festival. Or a chorus may be required merely to shout an exclamation, such as "Hail to our great king!" But in some works, the chorus plays a leading part in the story and sings complicated music.

An opera chorus is a large group of singers who perform as a unit. Members must be able to act expressively while they sing. The chorus above portrays an excited crowd outside a bull ring in a scene from Act IV of *Carmen* by Georges Bizet.

Acting in opera. For a successful career in opera, a singer must have acting skill in addition to an outstanding voice. Most young singers who plan a career in opera take several years of acting lessons.

Opera acting presents special problems because it is difficult to act and sing at the same time. Sudden movements, walking, running, and twisted body positions may all interfere with the production of a beautiful, clear, and steady tone. For this reason, opera acting tends to be less lively and less realistic than acting in other forms of drama.

The conductor plays a key role in opera. Throughout a performance, the conductor must keep the singers and orchestra together. The beat must be clearly seen by singers far from the conductor and by musicians sitting in the dim light at the ends of the orchestra pit. Although the conductor sets the tempo, he or she must be able to react to unexpected circumstances. If a soloist begins to sing too fast, for example, the conductor may have to adjust the orchestra's tempo. Because of all these special demands, opera conducting requires greater skills than does any other kind of conducting.

The conductor sets the tempo for both the musicians in the orchestra pit and the singers onstage. He or she must keep the orchestra and vocalists together. The conductor must also adjust the *balance* (loudness) between the singers and the orchestra.

Some operas call for scenes in which musicians and singers perform offstage. In such instances, an assistant conductor directs the offstage music. In some modern opera houses, the assistant conductor directs the offstage music while following the conductor's beat over closed-circuit television.

The orchestra. The number and kinds of instruments in the orchestra depend on the opera being performed. The instruments needed for Italian operas composed in the late 1700's differ greatly from those needed for operas written by Wagner in the late 1800's.

The particular opera being performed also determines the orchestra's function. In most operas, the orchestra's basic job is to accompany the singers. The accompaniment may be simple, providing only enough harmonic and rhythmic background to keep the singers on pitch and in time. But the orchestra may also serve a more important role. For example, it might play music that introduces the general emotional quality of an aria before a note has been sung. The orchestra may even emphasize a passage in the text. For example, a heavily rhythmic beat might accompany the words "my heart pounds faster."

In some scenes, characters may be on stage for a time without singing or speaking. During that period, the orchestral music expresses their feelings. Such characterization through music is one of the strengths of opera and is impossible in spoken plays.

In many operas, the orchestra often repeats a melody or short theme from an earlier scene. This melody or theme, without singing or spoken words, is called a *leitmotif.* Composers repeat the leitmotif to remind listeners of some action, character, or idea previously introduced in the opera. Composers of the 1800's, notably Wagner, used the leitmotif most effectively.

Pieces of orchestral music called *interludes* are used to connect scenes. Interludes provide time for scenery changes or for new characters to enter. Interludes also may indicate shifts in the emotional atmosphere in an opera. Occasionally, orchestral music imitates the sounds of nature. In Wagner's *Siegfried,* the orchestra imitates the sounds in a forest.

Most operas begin with an orchestral overture. Some overtures merely indicate that the performance is about to begin. But others have a more important function. Some introduce the opera's principal melodies. Others set the mood for the opening scene or for the opera in general. In some older operas, the overture lasts less than a minute. A number of overtures of the 1800's are elaborate pieces that run 10 minutes or longer.

Musicians occasionally perform onstage in costume and participate in the action of the opera. For example, musicians may take part in such onstage activities as a military parade or a religious procession.

Producing an opera

An opera company produces several operas in a season. In selecting each work for production, the company must consider several factors. These factors include the estimated cost of presenting the opera and whether the work will attract a large audience. Most opera companies attempt to balance their season with both comic and tragic operas. They also try to select works by a variety of composers and from different historical periods.

The people behind the scenes

During an opera performance, the audience sees only the conductor, orchestra, and performers. But an opera production also requires the skills of many other people. These people include (1) the general manager, (2) the stage director, (3) costume and set designers, (4) the members of the technical staff, and (5) the stage manager. All these specialists perform about the same work for an opera as they would for a spoken play. But opera requires that they coordinate all parts of the production with the music.

The general manager supervises the overall artistic and business policy of the opera company. This person plays a major part in choosing the repertoire and in hiring singers, conductors, and stage managers. The general manager follows each production through the planning and rehearsal stages to make sure it is progressing satisfactorily. Some companies have a music director to assist the general manager in such matters as the hiring of singers and conductors.

The stage director is responsible for the visual aspects of an opera production, just as the conductor is responsible for the music. The stage director must coordinate every action on the stage with the music. The director helps singers interpret their roles, works with the designers on ideas for costumes and sets, and helps determine the lighting. See **Theatre** (The director).

The stage director faces one of the greatest challenges in handling choral scenes. The chorus should not simply stand still and look at the conductor while singing. All dramatic illusion would be lost. The director must assign all members of the chorus some activity so they will appear natural on the stage. Some operas have scenes in which the chorus takes part in vigorous action while singing. One famous choral scene requiring vigorous action takes place near the end of Act II of Wagner's opera *The Mastersingers of Nuremberg.* A riot breaks out among a crowd of angry townspeople played by the chorus. In such scenes, the chorus must act convincingly while singing and following the conductor. The stage director has to plan choral scenes like these carefully and then rehearse the scenes frequently.

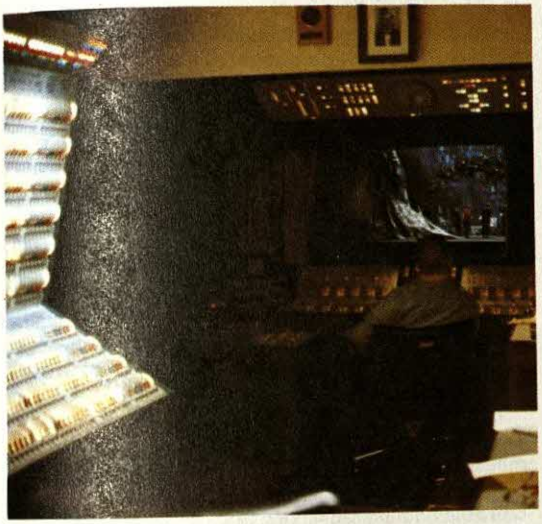
Sometimes, a stage director may create a new interpretation of an opera. Because the repertoire of opera companies consists chiefly of a few dozen works performed repeatedly, audiences may welcome a production that presents a familiar opera in a fresh way. But some directors have been criticized for taking too many liberties with an opera and thus distorting the composer's and librettist's intentions.

The designers. The story of most operas in the standard repertoire takes place before the 1900's. Therefore, the costume and set designers must generally research the particular period of the story so their designs accurately reflect the time and place of the action. In Giuseppe Verdi's *Aida,* for example, the costumes and sets must realistically portray ancient Egypt.

The costumes and sets should be designed so that the performers can move about freely. In addition, the set designer always has to consider the requirements of the music. For example, the music may allow a singer a certain amount of time to move from a door to a table and begin an aria. The designer must arrange the set so the singer can move naturally and still arrive at the table at the precise moment in the music when the aria be-

The set designer makes a scale model of a set, *foreground,* to determine how the scenery will look on the full stage. The workers in the background are painting a large backdrop for a set.

The costume designer creates costumes suitable to an opera's time and place. These designers fit a singer with a gown for Jules Massenet's *Manon,* which is set in the 1720's in France.

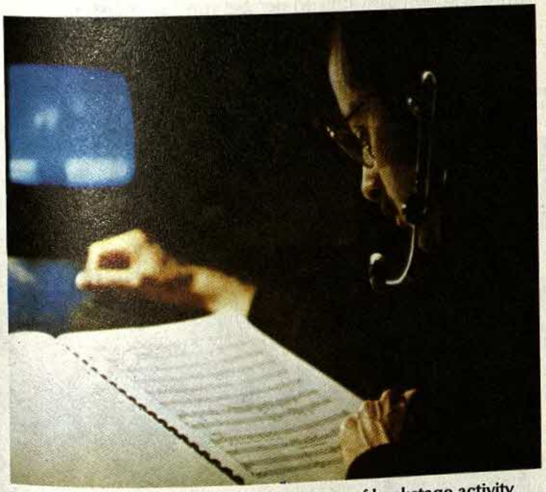


Opera rehearsals involve both technicians and performers. At a lighting rehearsal, *left,* an electrician in a lighting booth works with the director onstage to create desired lighting effects. The director also rehearses the singers, *right,* to develop stage movements and interpretations of roles.

gins. The set designer may also have to plan the sets to provide space for large choral or dance scenes. See Theatre (Scene design; Costumes and makeup).

The technical staff. Many technicians work with the stage director in planning and carrying out the visual aspects of the production. The electricians are especially important members of the technical staff. They operate the complicated lighting equipment that is used to illuminate parts or all of the stage and to provide atmosphere. Some stage directors rely on lighting, rather than on realistic sets, to express an opera's mood. See Theatre (Lighting and sound).

During an opera performance, the various crews of technicians and stagehands must work quickly and efficiently backstage. One crew changes the scenery between acts or scenes. Another crew adds the small ob-



The stage manager, *above,* has charge of backstage activity during an opera performance. He uses a score to follow the action onstage and watches the conductor over closed-circuit TV. He communicates with backstage technicians over a headset.

A crew of stagehands changes the scenery between acts and scenes, *right.* Another stage crew puts such objects as chairs and weapons in their proper places onstage. A third crew arranges the lights. The crews must work quickly and efficiently.

The prompter speaks the entire libretto during a performance in case a singer forgets a line. He works in a *prompter's box* below the stage where only the singers can see him. The prompter follows the conductor over closed-circuit television.

jects, called *props,* that the performers use in the action. A third crew sets up and adjusts the lights. For changing scenery, some opera houses use revolving stages or stages that can be raised or lowered by lift. Special technicians operate the machinery that moves these stages. See **Theatre** (Changing scenery).

The stage manager has charge of all backstage activity during a performance. He or she sees that all the props needed for a scene are on the stage and in the correct place. The stage manager calls the performers from their dressing rooms at specific times so they can make their entrances on schedule. The stage manager also gives the electricians cues to change the lighting during the performance.

Preparing a production

Planning a production. After a company selects an opera, the general manager and the management staff establish the production's budget. They also choose the cast and assign a stage director and conductor to the production. Most companies employ a resident group of singers, conductors, and directors for an entire season. However, nearly all companies also hire guest singers to take the leading roles for a single production. In addition, companies frequently use guest conductors, stage directors, and designers.

In some cases, the most important consideration in selecting an opera is whether a company can hire a particular guest singer. Sometimes a company wants a certain singer so much it will let the artist choose the opera. In casting the leading parts, the opera company first of all seeks singers who have outstanding voices. But the performers should also act well and, preferably, have the physical appearance suited to the characters they are to portray.

During the early stages of a production, the key personnel hold many conferences. The stage director, for example, meets frequently with the costume and set designers. Sketches of the designs must be approved early to allow enough time for the costumes and sets to be made. The costumes and sets may be manufactured in the opera house workshops or by outside firms. Sometimes, sets and costumes are borrowed or rented from another opera company.

Rehearsing a production. After many months of planning the production, rehearsals begin. At first, the singers, chorus, and orchestra rehearse separately in rehearsal rooms. If the opera calls for dancing, the dancers also practise by themselves.

The stage director rehearses the principal singers to work out stage movements and establish interpretations of the roles. The chorus rehearses under the direction of a chorus master. A *choreographer* (dance composer) supervises dance rehearsals. The conductor and the conductor's assistants rehearse the orchestra.

A few weeks before the opera is to open, rehearsals move from separate facilities to the main stage. These rehearsals take place with piano accompaniment only.

Meanwhile, the stage director and the chief electrician hold lighting rehearsals. In most operas, directors use elaborate lighting that is changed frequently during the performance. Lighting rehearsals develop the best ways to achieve desired effects. The rehearsals also set the timing for the various lighting changes.

As the opening nears, the orchestra rehearses with the entire cast on the main stage. Because of the central function of the music, the conductor takes charge of these rehearsals.

A few days before opening night, the performers and orchestra stage a dress rehearsal. A dress rehearsal is presented like an actual performance, with costumes, makeup, and sets. By this time, the production should move with split-second timing. The music sets the pace for the action and should not be sped up or slowed down to adjust to what happens onstage.

Offstage music is required in some operas. An assistant conductor leads the musicians and singers hidden in the wings. He conducts from a score while following the beat of the conductor in the orchestra pit over closed-circuit television.

The first operas were composed and performed in the 1590's in Florence, Italy. There, a group of noblemen, musicians, and poets had become interested in the culture of ancient Greece, especially Greek drama. This group, called the *Camerata,* believed that the Greeks sang rather than spoke their tragedies. The Camerata attempted to re-create the style of ancient Greek tragedy in musical compositions. They took most of their subjects from Greek and Roman history and mythology. The Camerata called their compositions *dramma per musica* (drama for music) or *opera in musica* (musical work). The term *opera* comes from the shortened form of opera in musica. Jacopo Peri, a member of the Camerata, composed what is generally considered to be the first opera, *Dafne* (1597).

Baroque opera

Opera emerged as an art form in western Europe during the *baroque* period in music history. This period began about 1600 and ended about 1750. Baroque music was elaborate and emotional. Italians composed the earliest baroque operas, and Italian-style opera dominated most of the period.

Early baroque opera. The first baroque operas consisted of recitatives, sung by soloists, and choral passages. A small orchestra accompanied the singers.

During the 1600's, the aria gradually emerged and developed as a separate function from that of the recitative. The recitative served to carry the plot of the opera forward. The arias became pauses in the action in which characters expressed their thoughts and feelings. Singers often used arias for showing off their vocal skills rather than for dramatic expression. A form of presentation called *secco recitative* developed in the 1600's. In secco recitative, the singers were accompanied by only a harpsichord—or by a harpsichord and cello or other bass instrument—rather than by the full orchestra.

Claudio Monteverdi, the first great composer of baroque opera, wrote the first opera masterpiece, *Orfeo* (1607). Monteverdi worked in Venice and made it the centre of opera during the early 1600's. The world's first public opera house, the Teatro San Cassiano, opened in Venice in 1637.

By the late 1600's, operas were being written and performed in a number of European countries outside Italy, especially in England, France, and Germany. But Italian opera was the accepted style, and many non-Italian composers wrote operas in the Italian manner and to Italian librettos.

Opera seria and opera buffa. Italian opera of the late baroque period developed into two basic types— (1) *opera seria* (serious opera) and (2) *opera buffa* (comic opera). Both types consisted of a succession of secco recitatives and arias.

Opera seria. Composers of opera seria based their works on stories of ancient kings and queens and mythological gods and goddesses. These stories provided spectacular stage effects, such as earthquakes and floods and big coronation or battle scenes. The operas stressed much coloratura singing and long arias. Many singers were trained in a vocal style called *bel canto,* which emphasized technical skill and beauty of tone.

The *da capo* aria became a major feature of opera seria. It had three parts, the third being a repetition of the first. In the repeated part, the singer was expected to add difficult notes, passages, and other ornamentation not included in the score.

Opera buffa began as comic skits, called *intermezzos,* performed in front of the curtain between the acts of an opera seria. The characters in opera buffa were common people, unlike the characters in opera seria. Characters in opera buffa represented the professions and social classes of the time, including doctors, farmers, merchants, servants, and soldiers. The typical opera

Engraving by Stefano della Bella of a scene from *The Wedding of the Gods* (1637) by Giovanni Carlo Coppola.

Opera seria was a form of Italian opera popular in the 1600's and 1700's. It emphasized spectacular scenery and often dealt with ancient gods and goddesses. The Italian designer Alfonso Parigi created the elaborate set at the left for an opera seria. It shows the workshop of Vulcan, the blacksmith to the gods in Roman mythology. Parigi designed the workshop as a cave at the foot of several towering cliffs.

buffa dealt with humorous situations from everyday life. Many characters in opera buffa sang in *dialects* (local forms) of Italian rather than the formal Italian of opera seria. A very successful opera buffa was *La Serva Padrona* (1733) by Giovanni Pergolesi.

Italian opera seria and opera buffa were extremely popular. Hundreds of them were written, often in a short time. Most of these works were performed for one season and then forgotten. Because of the constant demand for new operas, composers used the same librettos over and over again. By today's standards, many librettos had unconvincing plots and unbelievable characters. Although some operagoers complained about the weak librettos of many Italian operas, most audiences of the 1600's and early 1700's enjoyed the works, chiefly for their music.

French opera. A distinctly French style of opera appeared in the 1670's. Before that time, the French showed little interest in opera. The few operas performed in the country were written in the Italian style. Jean Baptiste Lully, though born in Italy, established a French form of opera. In the mid-1700's, Jean Philippe Rameau became the leading composer of French opera.

French opera composers avoided the secco recitatives and showy arias of Italian opera. Instead they preferred expressive melodies or simple songs. The recitatives were accompanied by a full orchestra and closely followed the rhythms of the French language. Ballet played an important part in French opera during the baroque period, as well as later.

In France, royalty became the chief patrons of opera. Lully acquired his fame at the court of King Louis XIV. The nobility in France and other countries competed with one another in maintaining large opera companies. To impress audiences with their wealth, the nobility sponsored productions noted for expensive scenic effects, such as gods riding chariots in the sky.

Classical opera

Dissatisfaction with Italian opera began to spread among operagoers during the early 1700's. Attacks centred on the far-fetched plots and lifeless characters in most operas. Many people particularly objected to the arias, which served only to glorify the singers. The reaction against Italian opera led to a new style, later known as *classical opera*. The classical period began about 1750 and lasted about 70 years. The first important classical composer was Christoph Willibald Gluck, a German. The greatest classical composer was Wolfgang Amadeus Mozart, an Austrian.

Gluck and opera reform. Gluck believed that the drama and music should be unified in opera. By integrating the music with the story in *Orpheus and Eurydice* (1762) and other works, Gluck put his beliefs into practice.

Gluck rejected improbable plots, elaborate scenic effects, and emphasis on showy arias. In his operas, the music served the story. Gluck simplified the action to make the stories and characters appear more natural. He also was one of the first composers to supervise all phases of a production, and he demanded many more rehearsals than had been customary.

Mozart, like Gluck, felt that the music in an opera should help make the story and characters believable. Mozart achieved this goal by carefully relating the instrumental and vocal music to the action. He showed particular skill in using music to create characterization—that is, to develop the personality of the characters. Mozart did this in ensemble scenes as well as in arias.

Mozart composed operas in both Italian and German. His best-known Italian operas are *The Marriage of Figaro* (1786), *Don Giovanni* (1787), and *Così Fan Tutte* (1790). His notable German operas include *The Abduction from the Seraglio* (1782) and *The Magic Flute* (1791). Both of these works contain elements of *Singspiel* (song play). Singspiel is a form of German opera that has spoken dialogue rather than recitative. Most stories are comic. The melodies often are simple and resemble the style of German folk and popular songs.

Opera in the 1800's

Romanticism was a movement from the late 1700's to the mid-1800's that emphasized emotionalism in the arts, including opera. The typical romantic opera had a setting in nature, a theme based on folklore or the supernatural, and colourful music. Carl Maria von Weber, a German, wrote one of the earliest and greatest romantic operas, *Der Freischütz* (1821). The story is set in a forest, and most of the chief characters are simple country people. The orchestra has an important part in portraying many of the sounds of nature as well as supernatural forces.

Several Italians also wrote in the romantic style. The most typical of these composers were Vincenzo Bellini and Gaetano Donizetti. Many of their operas require voices trained in the bel canto style.

Grand opera became popular in the early 1800's, especially in France. Composers of grand opera favoured heroic episodes from history, in which they could use crowd scenes, spectacular stage effects, and complicated and elaborate vocal and instrumental music. Giacomo Meyerbeer, a German, became the leading composer of French grand opera with such works as *Les Huguenots* (1836) and *Le Prophète* (1849). Gioacchino Rossini, an Italian-born composer living in France, also wrote a famous grand opera, *William Tell* (1829).

Giuseppe Verdi dominated Italian opera during the mid- and late 1800's. He is still perhaps the most popular opera composer in history. Verdi's best-known works include *Rigoletto* (1851), *Il Trovatore* (1853), *La Traviata* (1853), and *Aida* (1871). All are noted for their emotional power, which is expressed through eloquent vocal music. *Aida* is also an example of grand opera.

Verdi wrote his last two operas—*Otello* (1887) and *Falstaff* (1893)—when he was in his 70's. Both works demonstrate that old age did not diminish his genius. The operas are masterpieces of characterization through music, and they show complete unity of vocal and instrumental writing.

Richard Wagner was the most important German opera composer of the 1800's. Wagner believed that all the parts of an opera production—acting, costumes, drama, orchestral music, singing, and staging—should have equal value. He wrote his own librettos and, whenever possible, supervised the staging and other aspects of a production. Wagner departed from tradition by making the orchestra as important as the singers. In many of Wagner's late works, instruments perform the main melodies.

As a young man, Wagner was greatly impressed by Weber's romantic opera *Der Freischütz. The Flying Dutchman* (1843), one of Wagner's early works, shows similar romantic qualities. These qualities include the supernatural aspects of the plot and the musical representation of the forces of nature, such as the wind and the sea. In *The Flying Dutchman,* Wagner first used musical themes to identify certain characters, places, or ideas each time they appear in the drama. Wagner expanded this *leitmotif* technique greatly in his later operas. *Tristan and Isolde* (1865) and the four works called *The Ring of the Nibelung* (1876) represent Wagner's fully developed personal style.

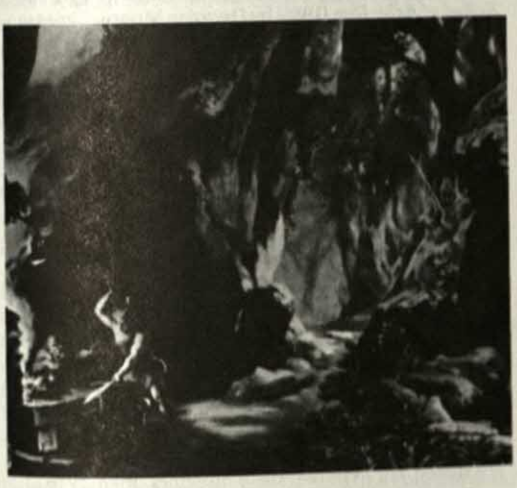
Nationalism—the feeling of pride in one's country—influenced many composers throughout Europe during the 1800's. These composers based much of their work on the folk music of their nation or region. Czech nationalism, for example, dominates the operas of Antonín Dvořák and Bedřich Smetana. *The Bartered Bride* (1866) by Smetana and *Rusalka* (1901) by Dvořák are outstanding examples of nationalistic operas. Russian composers of nationalistic operas include Modest Mussorgsky with *Boris Godunov* (1874) and Alexander Borodin with *Prince Igor* (1890).

Verismo opera. In the late 1800's, some Italian composers began to write grimly realistic operas dealing with everyday life. These *verismo* (meaning *true* or *realistic*) operas focused on violent emotions and actions. The earliest and best-known verismo operas are *Cavalleria Rusticana* (1890) by Pietro Mascagni and *Pagliacci* (1892) by Ruggiero Leoncavallo.

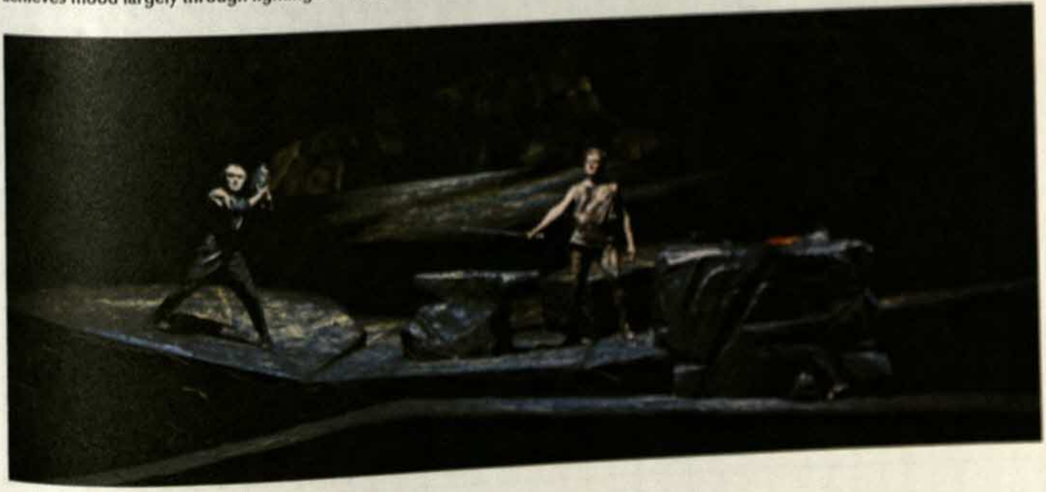
The 1900's

Giacomo Puccini was the most popular Italian opera composer of the early 1900's. His operas are noted for their melodic and sometimes sentimental music and for their theatrically effective librettos. Puccini first gained widespread attention in the 1890's with *Manon Lescaut* (1893) and *La Bohème* (1896). He followed these works with *Tosca* (1900), a verismo opera. His other notable operas include *Madama Butterfly* (1904) and *Turandot* (produced in 1926, after his death).

Richard Strauss became the most important and successful German opera composer after Wagner. Strauss wrote operas that require singers with great vocal power. He is best known for three early operas—*Salome* (1905), *Elektra* (1909), and *Der Rosenkavalier* (1911). *Salome* and *Elektra* originally caused much controversy among operagoers because of their brutal action and harsh music. *Der Rosenkavalier,* however, is entirely different in mood and theme. In this opera, Strauss and the librettist, Hugo von Hofmannsthal, created an af-



New techniques in staging have given a fresh interpretation to many older operas. At its première in 1876, Richard Wagner's opera *Siegfried* was presented in a realistic setting, *above.* A modern staging of the work eliminates the detailed scenery and achieves mood largely through lighting effects, *below.*



Bomarzo by Alberto Ginastera is one of the few modern operas to gain international fame. The tragic opera concerns the tortured mental state of Duke Bomarzo, a deformed Italian nobleman. In Act I, *above,* Bomarzo and his grandmother sing a duet.

fectionate portrait of Vienna's aristocracy in the 1700's.

The search for new forms. After World War I (1914-1918), many composers began to search for new forms of operatic expression. Some composers included elements of American jazz in their operas. Ernst Křenek, an Austrian, used jazz in his opera *Jonny spielt auf* (1927). The German composer Kurt Weill wrote *The Threepenny Opera* (1928) in the style of the music heard in German *cabarets* (nightclubs).

Meanwhile, a movement called *expressionism* had developed in the arts. Expressionism aimed at exploring the subconscious and became especially important in drama and painting. But expressionist qualities also appeared in several operas. Such operas had a brooding, nightmarish atmosphere, reinforced by unharmonious music and symbolic and violent actions.

Strauss's *Salome* was an early example of the expressionist style. But Alban Berg and Arnold Schoenberg, two Austrian composers, rank as the leading opera composers in the movement. Berg wrote *Wozzeck* (1925), the most successful expressionistic opera. Schoenberg's major expressionistic work was *Erwartung* (completed 1909, first performed 1924). Other operas related to expressionism include *Duke Bluebeard's Castle* (completed 1911, first performed 1918) by the Hungarian composer Béla Bartók and *From the House of the Dead* (1930) by the Czech composer Leoš Janáček.

British opera. Foremost among British opera composers in the mid-1900's was Benjamin Britten. His best-known opera is *Peter Grimes* (1945). Others include *The Rape of Lucretia* (1946), *Albert Herring* (1947), *Billy Budd* (1951), and *The Turn of the Screw* (1954).

Another outstanding British opera composer of this period is Sir Michael Tippett. His works include *The Midsummer Marriage* (1952) and *The Ice Break* (1977).

American opera. American composers wrote no important operas until the 1900's. George Gershwin wrote a highly original and popular American opera, *Porgy and Bess* (1935). The work describes life among blacks in Charleston, South Carolina, in the 1920's. *Porgy and Bess* has been acclaimed worldwide as a genuine American folk opera.

The most successful opera composer in the United States is Gian Carlo Menotti. He composes in a traditional style that shows the influence of Puccini. Menotti wrote an opera for radio, *The Old Maid and the Thief* (1939), and an opera for television, *Amahl and the Night Visitors* (1951). His best-known stage operas include two tense dramas, *The Medium* (1946) and *The Consul* (1950).

In addition to Menotti, other Americans have composed notable operas. These works include *The Mother of Us All* (1947) by Virgil Thomson; *The Jumping Frog of Calaveras County* (1950) by Lukas Foss; *Trouble in Tahiti* (1952) by Leonard Bernstein; *The Tender Land* (1954) by Aaron Copland; *Susannah* (1955) by Carlisle Floyd; *The Ballad of Baby Doe* (1956) by Douglas Moore; *Vanessa* (1958) by Samuel Barber; and *The Crucible* (1961) by Robert Ward.

Opera today

The experimentation in opera that began after World War I continues today. Some composers have explored new dramatic and musical techniques, including the use of electronic sounds, films, and colour slides. *Aniara* (1959), a science-fiction opera by the Swedish composer Karl-Birger Blomdahl, takes place in a space ship and uses taped and electronic sounds. *Bomarzo* (1967) by the Argentine composer Alberto Ginastera also features unconventional sound effects, especially in fantastic, dreamlike scenes.

Operagoers today, however, still prefer older, traditional works. Only a few operas composed since the end of World War I receive frequent productions. But many changes have occurred in the way older operas are staged. For example, stage directors often try to create desired moods through lighting effects made possible by modern lighting equipment. In many present-day productions, Wagner's operas are simpler and less realistic than they were in the 1800's.

Meanwhile, artistic and economic problems trouble all major opera companies. Before the development of fast, convenient air travel, leading singers remained with one company for an entire season. But jet travel enables singers to appear as guest artists in many opera houses in a season. Artists earn more money as guests, and audiences can see and hear many famous singers. However, travelling artists often follow a tight, exhausting schedule that leaves too little time for rehearsal. As a result, audiences often attend performances that show a lack of adequate preparation.

The cost of producing opera has risen steadily during the 1900's. Even if an opera house sells every ticket for an entire season, it cannot meet expenses. In Europe, ticket sales seldom provide more than half the income needed to operate an opera company. In the United States, companies rely on contributions from individuals, corporations, and foundations to make up losses. Many European countries, cities, and states support opera with public funds.

Opera companies today present mainly works composed between the late 1700's and the early 1900's. Almost all the operas that make up this standard repertoire were written by Austrian, French, German, Italian, and Russian composers. This section describes some of the most popular operas that are in the standard repertoire.

Aida, a tragic opera in four acts by Giuseppe Verdi. Libretto in Italian by Verdi and Antonio Ghislanzoni. First performed in Cairo, Egypt, in 1871.

The *khedive* (ruler) of Egypt asked Verdi to write *Aida* to help celebrate the opening of the Suez Canal and the Cairo opera house. The story takes place in ancient Egypt and concerns the tragic love affair between Aida, an Ethiopian slave, and Radames, an Egyptian military officer.

Aida is grand opera and so requires a large cast. The work has impressive crowd scenes, featuring choruses of soldiers, slaves, and priests, and an elaborate ballet. In Act I, Radames expresses his love for Aida in a beautiful aria, "Celeste Aida." Act II includes the stirring "Triumphal March," in which the Egyptian king reviews his victorious army.

Barber of Seville, The *(Il Barbiere di Siviglia),* a comic opera in two acts by Gioacchino Rossini. Libretto in Italian by Cesare Sterbini, based on the French play *The Barber of Seville* by Pierre de Beaumarchais. First performed in Rome in 1816.

The story of *The Barber of Seville* takes place in Seville, Spain, in the 1600's. This work is a good example of Italian comic opera, or *opera buffa.* The libretto has many characters and situations typical of this style. The characters include an old man (Doctor Bartolo) who is interested in a beautiful and rich young woman (Rosina). He jealously watches over her but cannot prevent a dashing young nobleman (Count Almaviva) from meeting and finally marrying her. Other traditional characters include a drunken soldier, who is really the count in disguise, and an irritable housekeeper. Figaro, the barber in the opera's title, helps the count win Rosina.

Rossini developed the action primarily through secco recitative. In Act I, Rosina's aria "Una voce poco fa" provides opportunities for brilliant singing. Also in Act I, Figaro makes his first appearance singing a popular comic aria, "Largo al factotum," in which he boasts how clever he is. The opera also has a lively overture, which Rossini had used in two earlier operas, *Aureliano in Palmira* (1813) and *Elisabetta, Regina d' Inghilterra* (1815).

Bohème, La *(The Bohemians),* a tragic opera in four acts by Giacomo Puccini. Libretto in Italian by Giuseppe Giacosa and Luigi Illica, based on the French novel *Scenes from Bohemian Life* by Henri Murger. First performed in Turin, Italy, in 1896.

The bohemians in the opera's title are four poor but carefree young men who live together in an attic in Paris about 1830. They are Rodolfo, a poet; Marcello, a painter; Schaunard, a musician; and Colline, a philosopher. Mimi, a frail young girl in poor health, is their neighbour. She and Rodolfo meet and fall in love. But at the end of the opera, Mimi dies. The main secondary plot deals with a stormy love affair between Marcello and a young woman named Musetta.

Although *La Bohème* ends tragically, it has many humorous and sentimental moments. The opera also has a number of Puccini's most beloved melodies. One of these melodies is "O soave fanciulla," a love duet between Rodolfo and Mimi that ends Act I. Perhaps the opera's most familiar melody is the aria "Musetta's Waltz" in Act II.

Boris Godunov, a tragic opera in a prologue and four acts by Modest Mussorgsky. Libretto in Russian by the composer, based primarily on the Russian play *Boris Godunov* by Alexander Pushkin. First performed in St. Petersburg, Russia, in 1874.

The opera takes place in Russia and Poland from 1598 to 1605 and concerns events in Russian history. Boris

The Barber of Seville by Gioacchino Rossini is one of the most popular comic operas. Act I ends in the wild argument shown here between Doctor Bartolo, *left centre,* and Count Almaviva, *right centre,* who is masquerading as a drunken soldier. Don Basilio, a music teacher, and Berta, a maid, try to hold back the doctor. Figaro, a barber, and Rosina, the count's sweetheart, attempt to restrain the nobleman.

La Bohème by Giacomo Puccini deals with a love affair between Rodolfo, a poet, and Mimi, a young seamstress in failing health. Near the end of Act IV, *above,* Rodolfo and the dying Mimi sing a beautiful love duet in the poet's attic lodging.

Godunov, an adviser to the czar, has the czar's young heir murdered. After the czar dies, Boris takes the throne. But in time, his feelings of guilt cause him to have visions of the murdered heir, and he finally collapses and dies. The "hero" of the opera is the Russian people, portrayed by the chorus. The chorus takes part in many scenes, including an impressive coronation.

Many musicians in Mussorgsky's time considered the music for *Boris Godunov* too harsh and crude. After Mussorgsky's death, his friend and fellow Russian composer Nikolai Rimsky-Korsakov wrote a completely new orchestration for the opera. Rimsky-Korsakov's version is often performed today.

Carmen, a tragic opera in four acts by Georges Bizet. Libretto in French by Ludovic Halévy and Henri Meilhac, based on the French story "Carmen" by Prosper Mérimée. First performed in Paris in 1875.

The action of *Carmen* is set in and near Seville, Spain, about 1820. Carmen is a beautiful Gypsy with no conscience or morals. While working in a cigarette factory in Seville, she meets Don José, a soldier, and has a love affair with him. Later, she leaves Don José for Escamillo, a bullfighter. At the end of the opera, Don José pleads with Carmen to return to him. After she scornfully refuses, Don José stabs the heartless girl to death in a jealous rage.

The exciting plot, colourful Spanish setting, and stirring music have made *Carmen* one of the most popular works in the repertoire. Many of the opera's melodies have become almost as familiar as popular songs. They

Boris Godunov by Modest Mussorgsky is a psychological tragedy based on events in Russian history. In the prologue to the opera, *above,* Russian peasants in Moscow bow before Boris shortly after he has been crowned czar. Members of the Russian nobility stand behind him.

include Carmen's dancelike arias "Habanera" and "Seguidilla" in Act I and Don José's "Flower Song" and Escamillo's "Toreador Song" in Act II. The opera also has rousing choral and dance numbers.

Cavalleria Rusticana *(Rustic Chivalry)*, a tragic opera in one act by Pietro Mascagni. Libretto in Italian by Guido Menasci and Giovanni Targioni-Tozzetti, based on the Italian story and play *Cavalleria Rusticana* by Giovanni Verga. First performed in Rome in 1890.

Traditionally, *Cavalleria Rusticana* is performed with Ruggiero Leoncavallo's two-act opera, *Pagliacci.* The passion, realism, and violence of both works make them major examples of verismo opera.

The action in *Cavalleria Rusticana* takes place in a Sicilian village in the 1800's. There, Lola, a married woman, has a love affair with Turiddu, a young soldier. The title of the opera refers to the villagers' code of honour. According to this code, Alfio, Lola's husband, must seek revenge. He challenges Turiddu to a duel and kills him.

The composer and librettists used several effective dramatic devices. Halfway through the opera, the villagers are in church, and the stage is empty. During this interval, the orchestra plays the "Intermezzo." This gentle, melodic instrumental piece provides relief from the tense, highly emotional atmosphere of the opera. In another dramatic device, Turiddu's death takes place offstage. The opera audience learns of the outcome of the duel through the horrified reactions of the villagers onstage.

Don Giovanni, a partly comic and partly tragic opera in two acts by Wolfgang Amadeus Mozart. Libretto in Italian by Lorenzo da Ponte. First performed in Prague, Bohemia (now part of the Czech Republic), in 1787.

Mozart's opera *Don Giovanni* has become the best-known version of the legends about Don Juan, the Spanish lover. The action takes place in and near Seville, Spain, in the 1700's. In the opening scene, Don Giovanni (Don Juan) flees from the home of Donna Anna after seducing her, and then he kills her father in a duel. Several later episodes further show Giovanni's cruel nature. At the end of the opera, the marble statue of Donna Anna's slain father visits Giovanni and urges him to abandon his sinful ways. Giovanni refuses. The scene is then enveloped in smoke and fire as he disappears into hell, dragged off by a chorus of demons.

Carmen by Georges Bizet describes the love affairs of a beautiful Gypsy. In this scene from Act IV, Carmen sings a duet outside a bull ring with her latest lover, the bullfighter Escamillo.

The mixture of comic and tragic qualities of *Don Giovanni* has always fascinated audiences. Leporello, Giovanni's servant, provides most of the comedy. The most

Don Giovanni by Wolfgang Amadeus Mozart has been praised as the greatest opera ever composed. It deals with the legendary Spanish lover Don Juan (Don Giovanni). Act I ends with this elaborate ball in Giovanni's castle.

tragic figure is Donna Anna. In addition to many beautiful arias, *Don Giovanni* has highly dramatic recitatives and long, complicated ensembles. In one scene in Act I, three orchestras onstage perform three different dance numbers at the same time during a party given by Don Giovanni. While the three onstage orchestras play, the opera orchestra in the pit accompanies the singers.

Faust, a tragic opera in five acts by Charles Gounod. Libretto in French by Jules Barbier and Michel Carré, based on part I of the German play *Faust* by Johann Wolfgang von Goethe. First performed in Paris in 1859.

The story of *Faust* takes place in Germany in the 1500's. Faust is an old philosopher who yearns for his lost youth. Mephistopheles, the Devil, appears to Faust and grants him youth. Faust, in return, agrees that after he dies, he will serve the Devil in hell. The opera centres on the love story between the now young Faust and Marguerite, a beautiful village girl. At the end of the opera, Marguerite dies and a chorus of angels escorts her to heaven. The Devil then drags Faust down to hell.

In the 1800's, the German composers Louis Spohr and Heinrich Zöllner and the Italian composer Arrigo Boito also wrote operas based on the story of Faust and his agreement with the Devil. But Gounod's version has become the most popular. The 1859 version had spoken dialogue. Gounod substituted recitative in a production first given in 1869, and that version is performed today. In Act III, Marguerite sings the beautiful "Jewel Song." The lively "Soldiers' Chorus" in Act IV is one of the best-known choral numbers in the entire repertoire.

Lucia di Lammermoor, a tragic opera in three acts by Gaetano Donizetti. Libretto in Italian by Salvatore Cammarano, based on the Scottish novel *The Bride of Lammermoor* by Sir Walter Scott. First performed in Naples, Italy, in 1835.

Donizetti wrote *Lucia di Lammermoor* in the melodramatic style typical of Italian romantic opera of the early 1800's. The story takes place in Scotland in the late 1600's. It concerns a doomed love affair between Lucia Ashton and Edgardo di Ravenswood. Enrico Ashton, Lucia's brother, wrongfully holds Edgardo's estate. To prevent Lucia and Edgardo from marrying, Enrico tricks Lucia into wedding another man. Lucia goes insane, kills her husband, and then dies. Edgardo hears of Lucia's death and stabs himself to death.

The opera has one of the most dramatic ensembles in the repertoire, the sextet "Che mi frena." It is sung in Act II at Lucia's wedding. But the opera is probably best known for the "Mad Scene" in Act III, in which the insane Lucia sings of an imaginary wedding between herself and Edgardo. This scene, which is extremely difficult to sing, is considered one of the greatest challenges for a coloratura soprano in all opera.

Madama Butterfly, a tragic opera in three acts by Giacomo Puccini. Libretto in Italian by Giuseppe Giacosa and Luigi Illica, based on the American play *Madame Butterfly* by David Belasco, from a story by John Luther Long. First performed in Milan, Italy, in 1904.

The story of *Madama Butterfly* takes place in Nagasaki, Japan, about 1900. Cio-cio-san (Madame Butterfly) is a Japanese girl who falls in love with an American naval officer, B. F. Pinkerton. They marry in a Japanese ceremony. According to Japanese law, either the husband or the wife may cancel the marriage on a month's notice. Pinkerton must leave Japan with his ship. After he has left, the girl gives birth to his child. Three years later, Pinkerton sends a letter saying that he has married an American. Shortly after the letter arrives, Pinkerton appears with his American wife. The heartbroken Cio-cio-san agrees to give them the child. She then commits suicide.

Puccini tried to give *Madama Butterfly* an Oriental flavour by basing some of his score on Japanese music. He also included a passage from "The Star-Spangled Ban-

Madama Butterfly by Giacomo Puccini describes a tragic romance between Cio-cio-san, a Japanese girl, and B. F. Pinkerton, an American naval officer. In Act I, the girl and her friends arrive for the marriage ceremony. Standing on a bridge in the garden, Cio-cio-san sings of her love for Pinkerton.

The Magic Flute by Wolfgang Amadeus Mozart is a fairy-tale opera. Act II, the final act, ends with this scene in the sacred Temple of Wisdom, ruled by the high priest, Sarastro. Marc Chagall, the famous Russian-born modern artist, designed this set.

ner" in one of Pinkerton's numbers. The opera's best-known aria is the exquisite "Un bel dì" in Act II. In it, Cio-cio-san describes the happiness she will feel when Pinkerton returns.

Magic Flute, The *(Die Zauberflöte),* a fairy-tale opera in two acts by Wolfgang Amadeus Mozart. Libretto in German by Emanuel Schikaneder and perhaps Karl Ludwig Gieseke. First performed in Vienna, Austria, in 1791.

Mozart and Schikaneder were both members of a secret society called the Masons, and much of *The Magic Flute* deals symbolically with Masonic beliefs and rituals. However, the opera can be enjoyed simply as a fairy tale about two lovers, Tamino and Pamina. The opera takes its name from a magic flute that protects Tamino from danger.

The opera has spoken dialogue instead of recitative. Some of the music resembles simple folk songs, though several of the arias are dramatic and solemn. The Queen of the Night, Pamina's mother, sings two arias that are showpieces for a coloratura soprano. They have extremely difficult passages and high notes. The overture is often performed as a separate work in concerts.

Marriage of Figaro, The *(Le Nozze di Figaro),* a comic opera in four acts by Wolfgang Amadeus Mozart. Libretto in Italian by Lorenzo da Ponte, based on the French play *The Marriage of Figaro* by Pierre Beaumarchais. First performed in Vienna in 1786.

Beaumarchais wrote *The Barber of Seville* before *The Marriage of Figaro.* Mozart selected the second play for his opera. Thirty years later, Gioacchino Rossini com-

Pagliacci by Ruggiero Leoncavallo is a tragedy about a company of travelling actors who stop in an Italian village to give a performance. In an aria in Act I, Canio, the leader of the company, describes the play the actors will present that night in the village.

posed an opera based on *The Barber of Seville.* The same principal characters appear in both works. The plot of *The Marriage of Figaro* follows the action begun in *The Barber of Seville.* Mozart's opera describes the problems when Figaro, servant to Count Almaviva, tries to marry Susanna, Countess Almaviva's maid.

Operagoers have praised *The Marriage of Figaro* for its vivid, realistic characters. Unlike many opera composers of the time, Mozart relied far more on ensembles than on arias to develop his characters. The opera opens with a humorous overture. It is one of the most popular overtures ever composed.

***Pagliacci** (The Players),* a tragic opera in a prologue and two acts by Ruggiero Leoncavallo. Libretto in Italian by the composer. First performed in Milan, Italy, in 1892.

A short verismo opera, *Pagliacci* deals with life among members of a travelling company of actors in Italy in the 1860's. The story concerns the jealousy of Canio, the leader of the players. The opera opens with a prologue sung by Tonio, who plays a clown. The prologue announces the theme of the drama.

Early in Act I, Canio learns that Nedda, his wife, is unfaithful. He discovers she is having a love affair, but he does not know the identity of the man. Canio sings one of the great tenor arias in all opera, "Vesti la giubba," which expresses his tragic fate of playing a clown while his heart is breaking. During a performance of a play, Canio learns that his wife's lover is Silvio, a peasant who lives in the village where the actors are performing. Canio then stabs Nedda and Silvio as the opera ends.

Porgy and Bess, a folk opera in three acts by George Gershwin. Libretto in English by Gershwin's brother Ira and DuBose Heyward, based on Heyward's novel *Porgy.* First performed in Boston in 1935.

Gershwin's *Porgy and Bess* is one of the few American operas that has achieved worldwide fame. The opera portrays life among black people in Charleston, South Carolina, in the 1920's. It specifically deals with the love of the crippled Porgy for the beautiful Bess. The story is colourful and highly dramatic, and it has considerable humour. In his score, Gershwin captured the flavour of the songs sung by black people of the Southeastern United States.

The opera consists largely of individual songs and choral scenes, connected by spoken dialogue and some recitative. Some of the songs, including "Summertime," "I Got Plenty o' Nuttin'," and "It Ain't Necessarily So," have become popular hits.

Rigoletto, a tragic opera in three acts by Giuseppe Verdi. Libretto in Italian by Francesco Maria Piave, based on the French play *Le Roi s'amuse* (The King is Amused) by Victor Hugo. First performed in Venice, Italy, in 1851.

The opera tells a story of treachery and revenge in the court of an Italian nobleman, the Duke of Mantua, in the 1500's. The chief characters include the duke; Rigoletto, a hunchback who is the duke's jester; and Gilda, Rigoletto's daughter. Through intrigue and deceit, Rigoletto's beloved daughter is murdered.

For *Rigoletto,* Verdi composed some of his most glorious melodies. In Act I, Gilda sings the beautiful aria "Caro nome," in which she expresses her love for the duke, who is disguised as a student. In Act III, the duke sings one of the most popular arias in the repertoire, "La donna è mobile." The aria is a humorous comment on how changeable women are in their affections. The emotional and melodic quartet "Bella figlia dell' amore" is sung later in Act III.

***Ring of the Nibelung, The** (Der Ring des Nibelungen),* a cycle of four operas by Richard Wagner. Libretto in German by the composer. The three main parts are *Die Walküre (The Valkyrie,* 1870); *Siegfried* (1876); and

Der Rosenkavalier by Richard Strauss portrays life among the aristocracy in Vienna during the 1700's. Part of the story concerns a romance between Octavian, a young nobleman, and Sophie, a wealthy young girl. They meet and fall in love in this scene in Act II. Octavian, *centre,* brings Sophie, *left,* a silver rose sent by Baron Ochs. The baron, a coarse, middle-aged nobleman, plans to marry Sophie.

Die Götterdämmerung (The Twilight of the Gods, 1876*).* Wagner called the fourth work, *Das Rheingold (The Rhine Gold,* 1869*),* the prologue to the other three. However, it is a complete opera. All four works were first performed as a cycle at the opening of the Festival Playhouse in Bayreuth, Germany, in 1876.

The four operas have a continuous plot based on ancient German and Icelandic legends. The Rhine-Maidens guard a treasure of gold on the bottom of the Rhine River. Alberich, one of a group of dwarfs called Nibelungs, steals the Rhine gold and makes a ring from it. The ring gives magic powers to whoever possesses it. After the ring is stolen from Alberich, he puts a curse on it. The ring changes owners several times during the four operas.

Many gods and goddesses take part in the action, including Wotan, their chief; and Fricka, his wife. Other important characters include Brünnhilde, one of several female warriors called Valkyries; Siegmund, a mortal son of Wotan; Siegfried, Siegmund's son; and Sieglinde, Siegmund's sister. The Ring cycle deals with the decline and downfall of the gods, brought about by their greed and lust for power as represented by the ring.

Rosenkavalier, Der *(The Bearer of the Rose),* a partly comic, partly serious opera in three acts by Richard Strauss. Libretto in German by Hugo von Hofmannsthal. First performed in Dresden, Germany, in 1911.

Unlike most opera texts, Hofmannsthal's libretto for *Der Rosenkavalier* is an outstanding work of literature. It glamorously portrays life among the aristocracy in Vienna in the 1700's. In most productions, the sets for the first two acts are spectacular, representing luxurious Viennese palaces. The work also calls for magnificent costumes.

The opera describes the love affairs of four chief characters: Princess von Werdenberg, called the Marschallin; Octavian, a young nobleman; Sophie, a beautiful girl; and Baron Ochs, a coarse and comic country nobleman. Strauss wrote the role of Octavian to be played by a female, and a mezzo-soprano sings the part.

Strauss composed many brilliant ensemble scenes for *Der Rosenkavalier.* One of the most impressive takes place in Act I when the Marschallin receives many visitors. The composer emphasized the light-hearted Viennese quality of the opera in a number of lilting waltzes. These waltzes are sometimes performed separately in concerts.

Salome, a tragic opera in one act by Richard Strauss. Libretto in German by Hedwig Lachmann; a translation of a play in French, *Salomé,* by the Irish-born author Oscar Wilde. First performed in Dresden, Germany, in 1905.

Wilde based his play on the story of Salome in the New Testament, but he invented many details that shocked audiences of his time. In Wilde's play, Salome, a 15-year-old girl, is attracted to the religious prophet Jochanaan (John the Baptist). After Jochanaan rejects her advances, she decides to take revenge. Salome's stepfather, King Herod, asks her to dance for him and, in return, promises her anything she wishes. Salome performs the famous "Dance of the Seven Veils" and then asks Herod for Jochanaan's head on a silver dish. Herod, though horrified, keeps his promise and has Jochanaan beheaded. Salome kisses the head of the prophet, an act that audiences of the early 1900's considered especially objectionable.

Salome by Richard Strauss is a passionate and violent opera that takes place in Palestine at the time of Christ. In the one-act opera's best-known scene, *above,* Salome performs the "Dance of the Seven Veils" before King Herod and his court.

Strauss's score captures perfectly the mood of Wilde's gruesome story. The music is often violent and harsh. At other times, it is vigorous and passionate. The orchestral music especially helps create the rich Oriental atmosphere of the opera. The role of Salome is one of the most difficult in the repertoire. The performer must not only sing extremely complicated music, but she must also act and dance well. In addition, she should look young and beautiful.

Tosca, a tragic opera in three acts by Giacomo Puccini. Libretto in Italian by Giuseppe Giacosa and Luigi Illica, based on the French play *La Tosca* by Victorien Sardou. First performed in Rome in 1900.

The story of *Tosca* takes place in Rome in 1800, when the city is torn by political intrigue. The chief characters are Floria Tosca, a famous singer; Mario, a painter and Tosca's lover; and Baron Scarpia, the villainous chief of police. In the story, Cesare Angelotti, an escaped political prisoner, has fled from Scarpia. Both Tosca and Mario know Angelotti's hiding place. Much of the action concerns Scarpia's attempts to force Tosca and Mario to reveal where Angelotti is hiding. Scarpia also wants to make Tosca his mistress. Tosca kills Scarpia and then commits suicide after she watches a firing squad execute Mario.

Puccini's music powerfully expresses the passion and violence of the plot. The work also has several beautiful melodies, including Tosca's "Vissi d' arte" in Act II and Mario's "E lucevan le stelle" in Act III.

Traviata, La *(The Wayward One),* a tragic opera in three acts by Giuseppe Verdi. Libretto in Italian by Francesco Maria Piave, based on the French play *The*

La Traviata **by Giuseppe Verdi describes a doomed love affair between Alfredo Germont, a young Frenchman, and Violetta Valery, his mistress. In this scene from Act I, the couple meet for the first time at a party given by Violetta at her home in Paris.**

Lady of the Camellias by Alexandre Dumas the Younger. First performed in Venice, Italy, in 1853.

Although *La Traviata* failed dismally at its première, it has become one of the most frequently performed works in the repertoire. Verdi set the action in and near Paris in the mid-1800's. The opera shocked many people during the mid-1800's because Violetta, its heroine, leads an immoral life.

Unlike many earlier operas, *La Traviata* has realistic characters with complicated emotions. Their thoughts and feelings seem especially convincing because of Verdi's theatrically effective music. For example, in Act I, Violetta tries to decide whether to fall in love with Alfredo, who loves her. The music clearly reflects her indecision. In Act III, she sings one of the opera's most haunting arias, "Addio del passato," in which she bids farewell to the happy days of the past.

Trovatore, Il *(The Troubadour)*, a tragic opera in four acts by Giuseppe Verdi. Libretto in Italian by Salvatore Cammarano, based on the Spanish play *El Trovador* by Antonio García Gutiérrez. First performed in Rome in 1853.

Like most of Verdi's operas, *Il Trovatore* tells a gloomy and violent story filled with passion. The action takes place in Spain in the 1400's. The principal characters include Manrico, a *troubadour* (poet-singer); Leonora, a noblewoman; Azucena, a Gypsy; and the Count di Luna. Manrico and Leonora are lovers, but the count also loves Leonora. In addition, di Luna and Manrico are brothers, though only Azucena knows it. Azucena seeks revenge against the count because his father had her mother burned at the stake. By the opera's end, Leonora has committed suicide and the count has executed Manrico. After Manrico's death, Azucena tells the count he has killed his brother, and she thus has her revenge.

Despite a frequently confusing plot, *Il Trovatore* is brilliantly effective theatre. The opera also has some of Verdi's most memorable music. In Act II, a band of Gypsies in their mountain camp sings what is perhaps the most familiar choral number in all opera, the stirring "Anvil Chorus."

Wozzeck, a tragic opera in three acts by Alban Berg. Libretto in German by the composer, based on the German play *Woyzeck* by Georg Büchner. First performed in Berlin in 1925.

Wozzeck is a private in the Austrian army about 1830. His superiors abuse and ridicule him. Even worse, Marie, the woman he loves, deceives him with another man. Driven almost insane by jealousy, Wozzeck stabs and kills Marie. Later, he throws the knife into a pond. Finally, he drowns while searching for the knife.

Much of the text for *Wozzeck* is set in an intensely emotional vocal style midway between spoken dialogue and singing. This style is known by the German term *Sprechstimme* (speaking voice). Most of the music is atonal—that is, it does not fall into the traditional keys.

Although *Wozzeck* is difficult to sing and play, it has been performed in many countries. Some people consider the music jarring and too hard to understand. But others feel that it effectively expresses a great variety of emotions.

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Overture
Singing

Outline

I. The elements of opera
  A. The libretto
  B. The music
II. Producing an opera
  A. The people behind the scenes
  B. Preparing a production
III. The development of opera
IV. The opera repertoire

Questions

Why is the libretto of most operas shorter than the text of a spoken play?
What qualities make *The Barber of Seville* an example of opera buffa?
Why is the role of Salome one of the most difficult in the repertoire?
What is the difference between recitative and arias?
What dramatic function does the "Intermezzo" serve in *Cavalleria Rusticana*?
How does a coloratura soprano differ from a dramatic soprano?
What was the *Camerata*?
Why does opera acting tend to be less lively and less realistic than acting in other forms of drama?
Who was the most important German opera composer of the 1800's? Of the 1900's?
What is the function of a general manager in an opera company?

Operation. See Surgery.

Operetta is a type of musical theatre that was popular from the mid-1800's to the 1920's. Operetta developed from French comic opera. However, unlike opera, operetta contains spoken dialogue instead of sung dialogue and songs instead of arias. An operetta overture is often a medley of songs from the show rather than a separate composition, as in opera.

Operettas are intended to entertain and amuse, not to arouse strong emotions or explore important issues. The plots of most operettas are romantic or satiric. They often involve confusion over mistaken identities and have happy endings, frequently with a moral. The music emphasizes straightforward melodies with strong rhythms. Other typical operetta elements include dances, often based on the waltz, and choruses.

Several national schools flourished during the period of operetta's greatest popularity. The form developed in France and its first masterpieces were written by Jacques Offenbach, a German-born French composer. His major operettas include *Orpheus in the Underworld* (1858), *La Belle Hélène* (1864), and *La Périchole* (1868).

In 1860, the Austrian composer Franz von Suppé wrote *Das Pensionat,* which became the model for Viennese operetta. However, the master of the Viennese school was Johann Strauss, Jr. Strauss turned the waltz into the rhythmical backbone of operetta music. His operetta *Die Fledermaus* (1874) is the greatest example of the Viennese school. Romantic Viennese operetta dominated the form in the early 1900's with the popularity of such works as *The Merry Widow* (1905) by composer Franz Lehár.

English operetta is most closely associated with the team of Sir William Gilbert and Sir Arthur Sullivan. Gilbert and Sullivan wrote satirical works that became popular throughout the English-speaking world, notably *H.M.S. Pinafore* (1878) and *The Mikado* (1885).

Related articles in ***World Book*** include:

Friml, Rudolf
Gilbert and Sullivan
Herbert, Victor
Lehár, Franz
Offenbach, Jacques
Romberg, Sigmund
Strauss (family)
Sullivan, Sir Arthur S.
Suppé, Franz von

Ophthalmia is a name for severe diseases affecting the eye membranes. These diseases may be caused by infections, poisons, or injuries. For example, *ophthalmia neonatorum* is an infection of the eyes of newborn babies, usually caused by the germ that causes gonorrhoea. *Sympathetic ophthalmia,* a rare condition, spreads to both eyes after an injury to one eye and can lead to blindness. See also **Blindness** (Diseases).

Ophthalmology is the field of medicine involving the diagnosis and treatment of eye diseases. An *ophthalmologist,* sometimes called an *oculist,* must have a medical degree and three to five years of specialized training in a hospital.

Ophthalmologists limit their medical practice to the eye. They examine the eye with special equipment and determine the degree of *refraction* in the lens of the eye. Refraction is a measurement of the eye's ability to see. If the examination shows that the patient needs glasses, the ophthalmologist gives the patient a prescription for them. Glasses are made by an *optician.* An ophthalmologist who discovers that an eye condition requires corrective surgery is qualified to perform the necessary operation.

By studying the retina, an ophthalmologist may discover signs of a disease of some other part of the body. For example, such diseases as diabetes, hypertension, and certain forms of anaemia may involve changes in the appearance of the retina.

See also **Surgery** (Surgical specialties).

Ophthalmoscope is an optical instrument for examining the interior of the eye. Ophthalmologists and opticians can diagnose many eye conditions by using the ophthalmoscope to examine abnormalities in the eye.

There are two types of ophthalmoscopes, the *direct ophthalmoscope* and the *indirect ophthalmoscope.* The direct ophthalmoscope contains a light, a prism and a mirror, and lenses. These parts are mounted in the head of the instrument, which is attached to a handle containing a battery. The prism and mirror project the light on the back of the eye. The lenses enable the examiner to focus the light to provide a clear, magnified view of the eye's interior. The indirect ophthalmoscope consists of a light worn on the examiner's head and a lens held in front of the patient's eye. This instrument enables the examiner to see a larger area than the direct ophthalmoscope does, but with lower magnification.

The ophthalmoscope was invented by a German physicist, Hermann von Helmholtz, in 1851 (see **Helmholtz, Hermann L.**). Helmholtz' instrument consisted of a sandwich of three thin plates of glass mounted at a 45-degree angle on a handle. A light was placed to the side of the eye under examination. Some light passed through the glass plates, but some was reflected into the eye. The lighted inside of the eye was observed through the glass.

An ophthalmoscope is used to examine the interior of the eye. The examiner peers through a tiny hole in the ophthalmoscope while focusing light into the patient's eye.

Opiate is any drug made from or containing opium. Opium is a dried milky substance obtained from unripened seedcases of the opium poppy plant. Morphine and codeine are opiates used for their healing properties. These drugs are *analgesics* (painkillers). Doctors prescribe them mainly for people with severe pain. Opiates also are used to help control coughing and severe diarrhoea.

Continued use of opiates can reduce their healing effects and can also lead to addiction. Therefore, opiates and synthetic drugs that have the same chemical structure as opiates have been made *controlled substances* by law. This means they can be obtained lawfully only by getting a prescription from a doctor or, in some cases, by signing a register at a pharmacy. Heroin is a highly addictive opiate. The sale and use of heroin is illegal throughout the world.

Opie, John (1761-1807), was an English painter of portraits and historical scenes. He is known for such paintings as *Juliet in the Garden* and also for his writings on art and his lectures. Opie was born near St. Agnes, in Cornwall. His early portraits interested Dr. Wolcot of Truro (Peter Pindar, the satirist and poet), who took the artist to London in 1780. Opie first exhibited at the Royal Academy in 1782 and was elected a Royal Academician in 1788.

Opinion poll. See **Public opinion poll.**

Opium is a drug that serves as the source of several medicines, including codeine and morphine. Heroin is also made from opium. Opium and most *opiates* (drugs made from or containing opium) can cause addiction. Many nations restrict their manufacture, distribution, and use.

Opium is made from the juice of the opium poppy. Processors near poppy farms make dried poppy juice, called *raw opium,* into a brownish powder known as *refined opium.* They also extract a yellowish powder called *morphine base* from the opium. Drug manufacturers use refined opium and morphine base to make codeine, morphine, and other medicines.

The opium poppy is a plant used to produce opium, a drug that is the source of heroin and several medicines.

Medical uses. Opium ranked as the most effective pain-relieving drug until the development of morphine in the early 1800's. Opium was also used to stop coughing and diarrhoea, to ease worry, and to cause drowsiness. Opiates serve many of the same purposes today. Doctors prescribe morphine to relieve severe pain. Codeine, probably the most widely used opiate, stops coughing. The opiate paregoric controls diarrhoea.

Opium addiction. The misuse of opium or of drugs made from it can lead to addiction. Opium, when first used, can give users a feeling of extreme calm and well-being. Their troubles may seem unimportant, and they temporarily live in an unreal world of isolated contentment. People smoke, sniff, or eat opium for these effects. But an addict may have vivid dreams and daydreams that may be extremely unpleasant. Opium addicts tend to neglect their health and their families.

Addicts who want to stop taking opiates can obtain medical treatment and counselling. Some experimental programmes use a drug called *methadone* to help patients overcome addiction to opiates.

History. The use of opium began at least 6,000 years ago in the Middle East. Greek and Roman physicians prescribed the drug before the time of Christ. Arabian traders took opium to China and India, probably starting in the A.D. 600's. At first, the Chinese used the drug chiefly as a medicine. European traders introduced opium smoking into China in the early 1600's. The Chinese government outlawed opium in 1729, but traders continued to exchange it for silk, porcelain, and other Chinese products. In the late 1700's, opium addiction became widespread among the Chinese. The opium trade helped cause the so-called Opium War (1839-1842), in which England defeated China (see **China** [Clash with the Western powers]).

During the 1800's, people in Europe and the United States could buy laudanum, morphine, and other opiates legally and without a prescription. By 1900, many people had become addicted to opiates. Addiction to opiates, particularly heroin, began to increase in the late 1940's and has continued to rise ever since. Today, a number of nations and international organizations co-operate in fighting the illegal manufacture and sale of opium and opiates.

Related articles in ***World Book*** include:

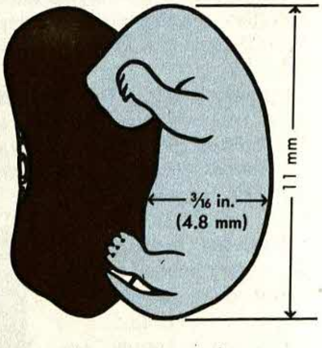
Codeine
Drug abuse
Heroin
Morphine
Poppy

Opium War. See **China** (Clash with Western powers).

Oporto. See **Porto.**

Opossum is any member of a family of furry mammals that live in the Western Hemisphere. The female opossum carries its young in a pouch on its abdomen. Opossums, kangaroos, and other mammals that give birth to extremely undeveloped young are called *marsupials.* Opossums are the only marsupials that are native to North America. They live from Ontario in Canada southward into South America.

A mother opossum carries its young on its back. Baby opossums stay in their mother's pouch for about two months after birth. They remain near her for several more weeks.



A newborn opossum is about the same size as a kidney bean.

There are many species of opossums, most of which live in Central and South America. Small, tree-dwelling *murine opossums* resemble mice. *Woolly opossums* have thick, soft fur. Another kind of opossum, the *yapok,* is the only marsupial that is adapted for living in water. Its webbed feet help make it a good swimmer.

The *common opossum* grows about as big as a house cat. It has rough greyish-white hair, a long snout, dark eyes, and big hairless ears. This opossum has a long tail that does not have much hair on it. The animal can hang upside down by wrapping its tail around a tree branch. It uses its sharp claws for climbing This opossum has 50 sharp teeth. Opossum tracks are easy to recognize because the animal has long, widely separated toes.

Opossums are born in groups of from 5 to 20. At birth, an opossum is only about as big as a kidney bean. The female opossum carries its tiny babies in a pouch on the outer skin of its abdomen for about two months after birth. After leaving the pouch, the young stay near the mother for several more weeks. When they can take care of themselves, the young go off on their own.

Opossums hunt at night. They eat almost any kind of animal or vegetable food. When in danger, opossums lie motionless and appear to be dead.

Scientific classification. Opossums make up the opossum family, Didelphidae. The common opossum is *Didelphis marsupialis.*

See also **Animal** (picture: Animals of the temperate forests); **Mammal** (picture: Marsupials); **Marsupial.**

Oppenheimer is the family name of two business leaders who played an important part in the development of mining in South Africa in the 1900's.

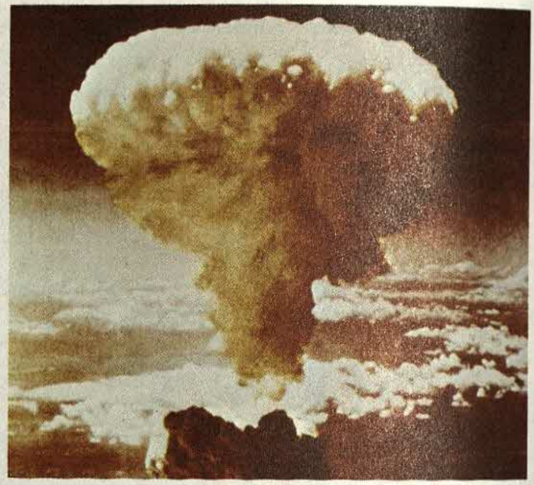
Sir Ernest Oppenheimer (1880-1957) was born in Friedburg, Germany. He was sent to Kimberley in 1902 by a London firm of diamond dealers. During World War I (1914-1918), he moved to Johannesburg and developed mines on the East Rand. This was the beginning of the Anglo-American Corporation. After the war, he acquired German diamond mining interests in South West Africa. His diamond interests helped him become chairman of De Beers Consolidated Mines in 1929.

Harry Frederick Oppenheimer (1908-   ), son of Sir Ernest, was born in Kimberley. He became chairman of De Beers and Anglo-American after the death of his father.

Oppenheimer, J. Robert (1904-1967), an American physicist, became known as the father of the atomic bomb. From 1943 to 1945, he directed the laboratory at Los Alamos, New Mexico, where the design and building of the first atomic bomb took place.

From 1947 to 1952, Oppenheimer headed the advisory committee of the newly formed United States Atomic Energy Commission (AEC). He also advised the U.S. Department of Defense and helped write the first United States proposal for international control of nuclear energy.

J. Robert Oppenheimer



J. Robert Oppenheimer's work was crucial to the development of the atomic bomb, which was first used against Japan.

In 1953, Oppenheimer's loyalty to the United States was questioned. The charges of disloyalty gave rise to probably the most famous American security hearing of the 1950's. Oppenheimer's opposition to the development of the hydrogen bomb, together with his past associations with Communists, led to an investigation in 1954 by an AEC security panel. The panel cleared Oppenheimer of all charges of disloyalty, but it denied him further access to secret information. In 1963, the AEC gave Oppenheimer its highest honour, the Enrico Fermi Award, for his contributions to theoretical physics. Many people viewed this as an effort by the U.S. government to correct a tragic mistake.

Oppenheimer was born in New York City. He graduated from Harvard University in 1925 after three years of study. In 1927, Oppenheimer received a doctor's degree from the University of Göttingen in Germany. From 1929 to 1947, Oppenheimer was on the faculty of the University of California at Berkeley, where he established a leading centre for research in theoretical physics. During that time, he also taught for part of each year at the California Institute of Technology. Oppenheimer served as director of the Institute for Advanced Study in Princeton, New Jersey, from 1947 to 1966.

Opperman, Sir Hubert (1904-   ), was Australia's champion road cyclist from 1924 to 1929. He captained the Australian teams that competed in the Tour de France in 1928 and 1931. In these month-long races, he repeatedly outlasted European riders. He won important road races in Europe, including the Bol d'Or in France in 1928 and the Paris-Brest-Paris road race in 1931. He created world records for time (24 hours) and distance (1,609 kilometres). He became a member of the Australian Parliament in 1949, and was minister for immigration from 1963 to 1966. Opperman was born in Rochester, Victoria.

Opposition is a term that describes the relative position of two celestial bodies when the earth comes closest to being directly between them. At full moon, for example, the moon is in opposition to the sun. The term is most commonly used to describe positions with respect to the sun. When a *superior planet*—that is, one whose distance from the sun is greater than the earth's—is on the opposite side of the earth from the sun, that planet is said to be in opposition. For example, the planet Mars is in opposition when the earth is between Mars and the sun.

Optic nerve. See Eye (The retina; diagram).

Optical disc is a flat, round platter on which sounds, pictures, or text are recorded. The discs are called *optical* because light is used to record and play back the information on them. Optical discs measure from 8 centimeters to 36 centimetres in diameter.

Optical discs are made of plastic with a thin coating of metal or other reflective material. A covering of clear plastic protects the disc from scratches and other damage. During recording, a device called a *laser* aims a concentrated beam of light at the disc (see **Laser**). The laser beam produces microscopic pits or marks on the disc that represent coded information. Most optical discs store information in a *digital* (numerical) code. During playback, a less powerful laser reads the code as the disc rapidly spins in a special disc player. The coded information is then changed back into sounds, images, or computer data.

Optical discs called *videodiscs* and *compact discs* (CD's) carry only prerecorded material. Videodiscs store programmes in an analog or nondigital form for reproduction on a television set. Most compact discs store sound of high quality for reproduction on a high-fidelity system. Some CD's hold pictures or text. The CD-V (*C*ompact *D*isc *V*ideo) stores sound and pictures for playback on a high-fidelity system and a television set. The CD-ROM (*C*ompact *D*isc *R*ead-*O*nly *M*emory) stores information for computers. Publishers use CD-ROM's to distribute electronic databases. Optical discs that carry prerecorded material cannot be erased or recorded over but research is being done to provide this facility.

Some kinds of optical discs enable users to record material themselves. The WORM (*W*rite *O*nce *R*ead *M*any times) disc can be used only once to record and cannot be erased. Many companies and government departments store important documents on WORM's. Erasable discs can be used over and over again for recording.

Optical discs may gradually replace magnetic tapes and magnetic discs for storing computer data. Optical discs can hold far more information than magnetic discs can. Optical discs can also withstand harder wear. As on magnetic discs, information can be found easily and quickly, usually in less than a second.

See also **Compact disc; Videodisc.**

Optical fibre. See Fibre optics.

Optical illusion. As we look down a long, straight road, we see that it seems to grow narrower in the distance. Trees and telegraph poles along the road appear to grow smaller as they stretch away toward the horizon. We know that a white house looks larger than the same house painted a dark colour, and that a person wearing a suit with up-and-down stripes looks thinner than he would if the stripes went crosswise. We call appearances of this kind *optical illusions* because we know from experience that in such cases things are not the way they appear to be.

Optical illusions of the kind described above are called "normal" illusions, because every person with normal eyesight experiences them. But an optical illusion does not occur every time we are deceived by what we see. Often we make mistakes in interpreting the impressions our eye receives. For example, many persons will read the sentence "he walked though the busy street," and never notice that the third word has no "r" in it. They *expect* to see "through" and therefore they *do* see "through." Such mistaken impressions are not optical illusions.

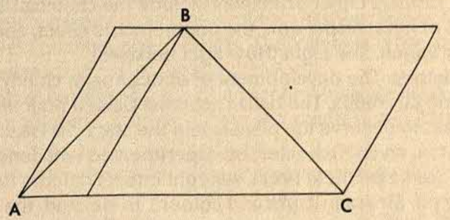
See also **Colour** (Surprising colour-vision effects); **Perception** (Factors affecting perception; illustration: Perceptual effects); **Mirage.**

Optical maser. See **Laser** (History).

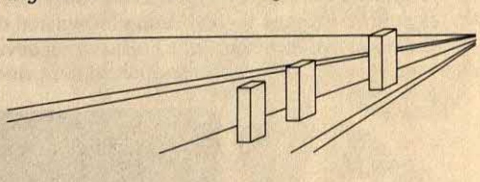
Optics is the branch of physics and engineering that is concerned with the properties of light. It describes how light is produced, how it is transmitted, and how it can be detected, measured, and used. Optics includes the study of visible light and of infrared and ultraviolet rays, both of which are invisible.

Many instruments, including binoculars, cameras, magnifiers, microscopes, projectors, and telescopes, operate according to the principles of optics. All these

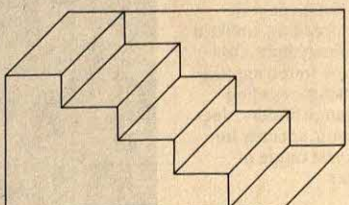
Some common optical illusions



Lines A-B and B-C in the above figure are equal in length. However, line B-C appears to be longer because of the angles of the other lines in the figure.



These blocks are all the same size, but the ones drawn to appear farther from the viewer seem larger. This illusion occurs because the blocks are not drawn in perspective.



This staircase has stairs that run up from right to left. But the figure can also be seen as an upside-down staircase, with the stairs running "up" from left to right.

instruments have optical devices, such as lenses and mirrors, which transmit and control light. Light is detected and measured with instruments called *light meters* (see **Light meter**).

Scientists have used the principles of optics to increase the number of ways to use light. For example, they can transmit light along a twisted or curved path by sending the light through a filament called an *optical fibre*. Scientists use a device called a *laser* as an important and powerful light source (see **Laser**). Communications networks now use computers and optical fibres to transmit large numbers of electronic signals.

There are three major branches of optics. *Physical optics* deals with the nature and behaviour of light as a wave. *Geometrical optics* is concerned with optical instruments and what happens when light strikes them. *Quantum optics* studies the nature of light as individual particles, known as *photons*.

Basic principles of optics describe what light is and how it behaves. To study visible light, scientists use a *prism* (wedge of glass) that produces a band of colours called the *visible spectrum*. Scientists analyse this and other spectra with an instrument called a *spectroscope*. See **Light** (The visible spectrum); **Spectrometer.**

Several reactions may occur when light strikes the surface of an object. Diffraction, interference, reflection, and refraction are basic principles that describe what may happen. Other principles include the chemical effects of light, dispersion, the photoelectric effect, and polarization. See **Light** (How light behaves).

History. The development of optics began chiefly during the 1600's. The Italian scientist Galileo built telescopes to observe the planets and the stars. Sir Isaac Newton, an English scientist, experimented with lenses and used a prism to break sunlight into its colours (see **Newton, Sir Isaac** [Light and colour]). In Holland, the physicist Christiaan Huygens studied polarization and proposed a wave theory of light.

During the early 1800's, two physicists, Thomas Young of England and Augustin Fresnel of France, did much to confirm Huygens' theory. Young formulated the principle of the interference of light. Fresnel then developed a mathematical formula that supported this principle. Most scientists accepted the work of Young and Fresnel as proof of Huygens' theory.

During the mid-1800's, accurate measurements of the speed of light were made by the French scientists Armand H. L. Fizeau and Jean B. L. Foucault. At about the same time, two German scientists, Robert Bunsen and Gustav Kirchhoff, showed that atoms of chemical elements produced specific lines in the spectrum. In 1864, the British physicist James C. Maxwell introduced the electromagnetic theory of light.

Scientists made several important discoveries in optics during the late 1800's and the 1900's. Such scientists as Albert A. Michelson of the United States, Frits Zernike of the Netherlands, and Dennis Gabor of England received the Nobel Prize for physics for work in optics.

See also **Light** and its list of *Related articles*.

Optometry is a profession devoted to the care of vision. Optometrists give eye health and vision examinations. They diagnose vision problems that affect a person's ability to see near and distant objects clearly and to judge distance. They also test the ability of the eyes to work together and to change focus easily. Optometrists prescribe glasses and contact lenses to correct faulty vision. They also may recommend vision therapy programmes to help a person overcome certain vision problems. If an optometrist diagnoses symptoms that indicate disease in the eye or any other part of the body, the person is referred to a doctor.

Oracle, in the ancient Greek world, was a shrine where people consulted special priests or priestesses. These priests and priestesses were believed to have the power to reveal the will of the gods and to foretell the future. The word *oracle* also refers to the priest or priestess and to the message or prophecy.

The most important oracle was in Delphi in central Greece. It was dedicated to the god Apollo. The priestess of Delphi, called the Pythia, sat on a large, three-legged stand. She often went into a trance and talked hysterically. The Greeks believed that Apollo spoke through the Pythia during these trances. In most cases, the meaning of the Pythia's oracles was unclear, and priests at the shrine interpreted them for the public.

Most oracles were dedicated to Apollo. Some were

A scientist experiments with pencil-thin beams of an optical laser. A laser beam can travel long distances with only slight spreading, unlike a beam of ordinary light. Optical lasers have found applications in automatic reading machines, range finders, decorative lighting, security images, and a vast range of other devices.

dedicated to Zeus or other gods. One famous oracle of Zeus was in a grove of oak trees in Dodona in northwestern Greece. The people believed that Zeus spoke through the rustling of the oak leaves. The priests at Dodona interpreted these rustlings. Other important oracles were in Italy, Libya, and Syria.

See also **Delphi.**

Oral contraceptive. See **Birth control.**

Oran (pop. 663,504) is a Mediterranean Sea port in Algeria. It lies about 360 kilometres west of Algiers (see **Algeria** [map]). Oran trades with cities of inland Africa and ports of southern Europe. It was built by the Moors, and some of the old Moorish buildings are still standing. The city was captured by the Spaniards in 1509, by the Turks in 1708, and again by the Spaniards in 1732. Spain abandoned Oran after it was destroyed in 1791 by an earthquake. In 1831, the French rebuilt Oran. American forces were stationed there in World War II.

Orange. See **Colour.**

Orange is a popular citrus fruit enjoyed by people throughout the world. Oranges are valued for their delicious juice and high vitamin content. They are an excellent source of vitamin C and also contain vitamin A and several B vitamins.

About 38 million metric tons of oranges are harvested throughout the world each year. Brazil is the leading orange-producing nation, followed by the United States and Spain. Italy, Israel, India, and Egypt are all large orange-producing countries.

More than half of the oranges grown around the world are processed into fresh, canned, or frozen concentrated juice. About one-quarter of the orange crop is sold as fresh fruit. The remaining fruit is used in making baked goods, sweets, marmalade, salads, and soft drinks.

There are several types of oranges, the most popular of which is the sweet orange. Oranges vary in shape from round to oval, and they range from pink to orange to dark red in colour. They grow best in regions with warm summers and cool winters in which the temperatures do not go below freezing. Freezing temperatures can severely damage the tree and the fruit.

The fruit and the tree

The orange is a type of berry called a *hesperidium.* Its soft, leathery peel covers its fleshy, edible interior. The peel consists of a coloured outer layer called the *flavedo* and a white, spongy inner layer known as the *albedo.* The flavedo contains tiny glands that produce a strong, spicy oil. The interior of the orange consists of 10 to 15 segments, which surround a spongy core. The segments contain many *juice sacs,* which hold the juice and make up the pulp of the orange. The segments of some varieties of oranges also contain seeds. Other varieties are seedless.

The orange tree has dark green leaves and beautiful, white, fragrant flowers. Fruit develops from the ovaries of the flowers. Some varieties of oranges ripen within 8 months after the flowers bloom. But others require up to 20 months. Growers plant different varieties of oranges in the same area so that mature fruit is available during most or all of the year.

Orange trees develop during periods of rapid growth called *growth flushes.* During such periods, new stems, leaves, and blossoms appear on the trees and some of the flowers develop into fruit. The number of growth flushes that occur each year varies according to the climate. The climate also determines when the flushes take place. For example, in rainy, tropical climates, many small flushes occur throughout the year. At such times, the trees produce only a few blossoms, and the fruit that develops may be small and of poor quality. In subtropical regions, growth flushes do not occur during the winter. Instead, a period of vigorous growth takes place in the spring, during which many flowers appear on the trees and a large number of fruit develop. Several smaller flushes may occur during the summer, but these result in only stems and leaves being produced.

Varieties

The word *orange* commonly refers to three types of citrus fruit: (1) sweet oranges, (2) sour or Seville oranges, and (3) mandarins.

Sweet oranges. Growers around the world produce more sweet oranges than any other type. These oranges have a sweet flavour and are round to oval in shape. There are three groups of sweet oranges: (1) common oranges, (2) navel oranges, and (3) blood oranges.

Common oranges are the most important type of sweet orange. Most oranges sold as fresh fruit are common oranges. In addition, almost all orange juice is made from common oranges. Juice from the seedless Valencia orange, a type of common orange, makes the highest quality juice products. The Valencia is the most popular variety of orange in the world.

Navel oranges have a small second fruit growing at one end of the main fruit. They are seedless and have a

Oranges are popular citrus fruit that contain delicious juice and large amounts of vitamin C. These are grown in warm regions throughout the world.

Workers harvest oranges in a citrus grove. Oranges that are to be sold whole must be picked by hand to prevent damage.

pleasant flavour, but they produce less juice than do common oranges.

Blood oranges have an unusual colour, but in other ways are similar to common oranges. The flesh and peel of blood oranges range in colour from pink to red. Blood oranges are widely grown in Mediterranean countries. Few are planted in other areas of the world.

Sour or Seville oranges generally are not eaten fresh because the flesh has a bitter taste. Seville oranges are grown mainly in Europe and are widely used in making marmalade. Oils from the peel of Seville oranges and ingredients from the leaves and flowers are used in manufacturing perfume.

Mandarins, also called tangerines, are not really oranges, though they are often referred to as such. Instead, mandarins are a separate group of similar fruit that includes true mandarins, tangelos, tangors, and other orangelike fruit. Mandarins taste sweet and are generally eaten fresh. Their peel separates easily from their edible interior. See **Mandarin; Tangelo; Tangerine; Tangor.**

Growing oranges

Planting and caring for orange trees. Most orange trees are grown from buds in special nurseries. The buds are cut from trees that produce the variety of oranges desired and are then grafted to seedling orange trees called *rootstocks* (see **Grafting** [Other kinds of grafting]). Rootstock varieties are selected for their ability to adapt to the soil and climate of the area of production and for their resistance to pests and disease. Orange trees are transplanted in orchards 6 to 12 months after grafting. They start to bear fruit 4 or 5 years later and may produce oranges for 50 years.

Pests and diseases. Orange trees may be attacked by many pests and diseases. Scale insects, one of the most destructive enemies of orange trees, suck the sap from the leaves and twigs. Certain wasps kill these insects, and so growers fight scales by fostering the growth of these wasps in the orange groves. Two other sucking pests, rust mites and aphids, also damage the leaves of the trees. These pests are killed by spraying the trees with pesticides.

At a packing house, *above,* oranges that are to be sold as fresh fruit are sorted according to grade and size. They are then packed in boxes for shipping to markets.

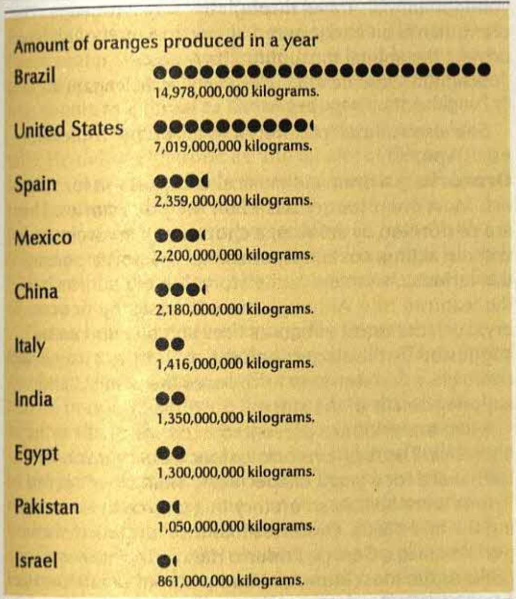
Virus diseases weaken or kill orange trees. The virus disease *tristeza* is especially deadly. Growers fight these diseases by planting virus-free trees from nurseries or trees that can resist or tolerate the viruses. Such fungal diseases as *melanose* and *greasy spot* also cause extensive damage to orange trees. Melanose produces tiny, raised dots on the stems, leaves, and fruit. Greasy spot causes oily-looking blotches to appear on the leaves. Growers control fungal diseases by spraying the trees with fungicides.

Harvesting and processing. As oranges mature, the amount of sugar and juice they contain increases and their acid content decreases. Oranges differ from most other fruit in that they do not mature further after they have been harvested. For this reason, growers pick the oranges only when the fruit contains the required levels of juice, sugar, and acid.

If oranges are pulled roughly from the trees or harvested mechanically, they may be bruised or damaged, especially at the point where the stem joins the fruit. These damaged fruit may be easily attacked by fungus diseases. For this reason, oranges that are to be exported as fresh fruit are picked from the trees by hand. These oranges are then washed and dried. Next, they are waxed with a coating containing fungicides and pesticides. This coating also reduces the risk of damage during shipment.

Oranges that are to be sold for processing can be harvested mechanically. If they are processed within a

Leading orange-growing countries



Figures are for 1987. Source: Food and Agriculture Organization of the United Nations.

few days after harvesting, no serious fruit losses are suffered from bruising or decay. The juice is extracted from the fruit by machine and is then pasteurized to kill harmful bacteria and enzymes.

History

Oranges are among the oldest cultivated fruit. People have grown oranges for more than 4,000 years. Oranges probably originated in the part of Asia that now includes India, Burma, and southwestern China. By the A.D. 800's, Arab traders had introduced oranges into eastern Africa and the Middle East. In the 1400's, Portuguese travellers carried oranges from India to Europe. The Italian explorer Christopher Columbus took orange seeds to America in 1493. All major varieties of oranges grown today are modern varieties that were developed during the 1800's.

Oranges grow well in Florida, U.S.A., but in some years the fruit and trees may be damaged, *above,* by frost.

Scientific classification. Oranges are members of the rue family, Rutaceae. Sweet oranges belong to the species *Citrus sinensis.* Seville oranges are classified as *Citrus aurantium.* Mandarins are the fruit of several species and their hybrids. Common mandarins belong to the species *Citrus reticulata.*

Orange (pop. 32,846) is a city in New South Wales, Australia. It stands on the Mitchell Highway, west of Bathurst, about 865 metres above sea level. The district around Orange produces pears, cherries, apples, plums, and potatoes. Farms in the area raise livestock, including sheep, lambs, and beef and dairy cattle. Orange is the commercial centre for more than 60,000 people. A large manufacturing plant at Orange makes refrigerators, washing machines, air conditioners, and cookers. Thousands of visitors go to see field demonstrations of farm machinery at the national field days held in Orange each November.

Mount Canobolas rises 1,395 metres about 18 kilometres from the city. Its name is derived from a two-word Aboriginal phrase, *Coona Booloo,* which means *two heads* or *twin shoulders.*

Orange Day. See **Northern Ireland** (People).

Orange Free State. See **Free State.**

Orange Order. See **Northern Ireland** (People).

Orange River is the longest river in South Africa. It flows westward across the southern part of the African continent. Sand bars and shallow waters make the Orange River useless for navigation. However, the river serves as an important source of hydroelectric power and provides much-needed water for irrigation projects. In some areas, the gravel of the river contains diamond deposits. For location, see **South Africa** (terrain map).

The Orange River rises in the mountains of Lesotho and flows into South Africa. It winds west and northwest for about 2,100 kilometres. It empties into the South Atlantic Ocean at Alexander Bay. The upper river forms the border between Eastern Cape and Free State, two provinces of South Africa. It then flows across the plateaus of central South Africa to the town of Prieska. From Prieska to the Augrabies Falls, the elevation of the river drops steadily. The lower course of the river stretches from the Augrabies Falls to the western coast, flowing through rugged desert country.

Much of the Orange River is narrow, with deep gorges. A large sand bar blocks the mouth of the river and prevents passage by seagoing ships. The river has two major tributaries—the Vaal and Caledon rivers.

The Orange River was named in honour of the Dutch Prince of Orange in the late 1700's. Robert Gordon, a Dutch military commander in South Africa, chose the name. Africans who lived in the area had called the river the Gariep. During the 1860's, diamonds were discovered along the river's course. In 1962, the South African government announced a development plan for the Orange River. Since then, the government has built dams on the river to provide hydroelectric power. It has also built canals and tunnels to irrigate nearby land and to provide flood control.

Orangemen are members of the Orange Society, an organisation based in Northern Ireland which supports Protestant Christianity and civil and religious freedom. Its official title is the Loyal Orange Institution. Orangemen meet regularly in groups called *lodges.* They hold annual parades on July 12, the anniversary of the Battle of the Boyne. On parade, they wear decorations such as orange lilies and orange sashes. Most Orangemen live in Northern Ireland, but there are lodges in England, the Republic of Ireland, Scotland, and several other countries. Ulster Protestants formed the Orange Society in the late 1700's. They named it after William III (William of Orange), who defeated James II at the Battle of the Boyne in 1690.

Orangutan is a large, rare ape that lives in the rain forests of Sumatra and Borneo. The name *orangutan* comes from a Malay word meaning *man of the woods.* The orangutan stands 90 to 150 centimetres tall, and has coarse reddish-brown hair. Males may weigh from 70 to 90 kilograms. Some males have an arm spread of about 2 metres, one of the largest of all the apes. Females are about half as large as males. The orangutan's arms reach to its ankles when the animal stands.

The orangutan spends most of its time in trees, though it does come down to the ground occasionally. It moves carefully through the forest canopy by climbing with its arms. It also sometimes uses its arms to swing from branch to branch. This type of movement is called *brachiation.* The orangutan builds a nest in the trees to sleep in during the night. These nests are from 5 to 25 metres above the ground. Orangutans eat mainly fruits. They also eat leaves and insects.

Orangutans are silent, peaceful animals. People are their main enemy. Orangutans usually live alone, but a young orangutan stays with its mother. Sometimes two younger animals travel through the forest together. The orangutan is an endangered species, even though laws protect the animal throughout its range.

An orangutan is an ape that spends most of its life in trees. The animal uses its long arms to swing from branch to branch.

Scientific classification. The orangutan belongs to the family Pongidae. It is *Pongo pygmaeus.*

See also **Animal** (picture: Animals of the tropical forests); **Ape.**

Oratorio is a dramatic musical composition for singers. Most oratorios are based on religious stories. They are performed by soloists, a chorus, and an orchestra without acting, costumes, or scenery. Soloists portray the various characters in the story, but the chorus has the featured role. Although there is no acting or scenery, such theatrical effects as fires and storms can be suggested by the singers and the orchestra. Many oratorios have a narrator who introduces the soloists and supplies details of the story.

Most oratorios are presented in concert halls or in churches. The term *oratorio* comes from *oratorium,* a Latin word for a small chapel. Performances of sacred hymns were held in an oratory in a church in Rome during the mid-1560's. Oratorios had their origins in these performances. George Frideric Handel of Germany ranks as the most important composer of oratorios. His *Messiah* (1742) is the most famous oratorio ever written. The German composers Johann Sebastian Bach and Felix Mendelssohn and the Austrian composer Joseph Haydn also wrote important oratorios.

See also **Cantata; Handel, George Frideric; Opera** (introduction); **Passion music.**

Oratory is the art of skilful speaking. It is also called *rhetoric.* An *orator* is a speaker who tries to influence listeners by eloquent speeches. An orator follows the rules of oratory. For some of the rules used today, see **Public speaking; Debate.**

Beginnings. A mass of lawsuits arose when a democracy was established in Syracuse in Sicily in 466 B.C. They were brought by former exiles whose property had been seized by the tyrants. Many claims were several years old, and documentary evidence was often lacking. The claimants needed help in presenting their cases. Corax, a Sicilian Greek, was the first to supply this help, and is considered the founder of oratory. He established a system of rules for public speaking in the 460's B.C., with the aid of his pupil Tisias. Corax said that a speech usually should have five parts: (1) *proem* (introduction); (2) narrative; (3) arguments; (4) subsidiary remarks; and (5) summary.

Other early teachers of rhetoric include Protagoras, who developed the principles of debate; Gorgias, who emphasized style; Hippias, who was chiefly interested in the use of memory; and Lysias, who "showed how perfect elegance could be joined to plainness."

The study of speechmaking spread to Athens. During the 400's B.C., almost all male Athenian citizens attended the general assembly, where public policies were debated. They took part in the formulation of policies and the administration of justice. In the courts, they acted as jurors. The decision in each case rested with the jury, because there were no judges. Those who brought the charges and those who defended themselves pleaded their own cases. This led to a study of speechmaking.

Classical orators. The first great Greek orator was

Pericles. His speeches were reported by Thucydides in his famous *History of the Peloponnesian War.* Pericles' Funeral Oration is his best-known speech. The greatest Greek orator was Demosthenes. He is best known for his *Philippics,* speeches in which he attacked Philip II of Macedonia as a threat to Greek independence.

The outstanding Greek writer on rhetoric was Aristotle. He defined rhetoric as "the faculty of discovering in every case the available means of persuasion." Aristotle emphasized three methods of proof: (1) *ethical* (the influence of the speaker's personality); (2) *pathetic* (the influence of the speaker's use of emotional appeal); and (3) *logical* (the influence of the use of formal principles of reasoning in proof).

Cicero holds first place among the important early Roman orators. Authorities believe that the *Rhetorica ad Herennium* was written by Cicero about 86 B.C. It states that an orator must divide the preparation of a speech into five steps. These steps are: (1) *invention* (analysis of speech situation and audience, investigation and study of subject matter, and selection of speech materials); (2) *disposition* (the arrangement of the speech materials under what we now call introduction, discussion, and conclusion); (3) *style* (the use and grouping of words to express ideas clearly, accurately, vividly, and appropriately); (4) *memory* (methods of memorizing material); and (5) *delivery* (the oral presentation).

Book I of Cicero's *De Oratore,* written about 55 B.C., develops the theme that a great orator must be a person of great learning and that the "proper concern of an orator . . . is language of power and elegance accommodated to the feelings and understandings of mankind." Book II emphasizes the importance of invention and disposition, with particular attention to court oratory. Book III deals with style and delivery. Here, Cicero shows that an orator should speak "correctly, perspicuously, elegantly, and to the purpose."

Institutio Oratorio (*The Training of an Orator*), written by Quintilian about A. D. 90, was a complete manual for the training of public speakers. Even today, it is one of the most comprehensive works on training speakers.

Later orators. With the coming of Christianity, the preacher replaced the political speaker. Famous early preachers include Paul, John Chrysostom, and Augustine. Outstanding speakers for religious reform were Savonarola in the late 1400's and Martin Luther and John Calvin during the Reformation in the 1500's.

Political oratory again became important in the 1700's. During the French Revolution, Comte de Mirabeau spoke for the common people fighting royal authority.

Great Britain has produced many distinguished speakers. They include Edmund Burke, Benjamin Disraeli, William Gladstone, and Winston Churchill.

Related articles in *World Book* include:

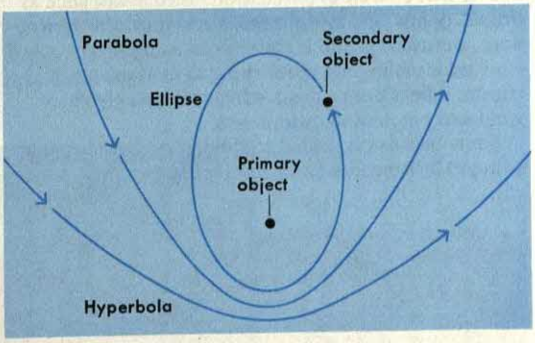
Famous orators

Burke, Edmund
Churchill, Sir Winston
Cicero
Clay, Henry
Demosthenes
Douglass, Frederick
Gladstone, William Ewart
Hamilton, Alexander
Henry, Patrick
Isocrates
King, Martin L., Jr.
Lysias
Mirabeau, Comte de
Pericles
Phillips, Wendell
Pitt (family)
Quintilian
Webster, Daniel

Orbit is the path of a natural or artificial object that moves under the influence of a central force. In astronomy, the term *orbit* refers specifically to the path of any object whose motion is controlled by the gravitational pull of another object. Astronomers call the more massive of the two objects the *primary,* and the less massive one the *secondary.* The moon, for example, is a secondary that revolves around its primary, the earth. The earth, in turn, is a secondary that travels around its primary, the sun. Spacecraft can become secondaries of the earth or another planet, or of the moon or the sun.

The orbit of a secondary object within the gravitational pull of a primary object is a closed curve called an *ellipse.* Perfectly circular orbits rarely occur. In an elliptical orbit, the primary is not in the centre of the ellipse. As a result, the secondary travels closer to the primary at certain times than at others. The point in the orbit where a secondary of the earth is nearest the earth is called the *perigee.* The farthest point is the *apogee.* For a secondary of the sun, the nearest point in the orbit is the *perihelion* and the farthest point is the *aphelion.*

A secondary object may gain enough speed to escape the gravitational pull of its primary. If it attains such *escape velocity,* its orbit becomes an open curve called a *parabola.* If a secondary moves faster than escape velocity, its orbit is a flatter open curve called a *hyperbola.* A spacecraft that leaves its orbit around the earth starts travelling along a hyperbolic orbit.



The shape of the orbit taken by a *secondary* object around a *primary* object may be an ellipse, parabola, or hyperbola, as shown in the diagram above. The shape is determined by the speed of the secondary in relation to the speed required to escape from the primary.

Spacecraft travel to other planets in the solar system, using *gravity-assist trajectories.* The orbit is modified each time the spacecraft passes closely by a planet. During the *flyby,* the gravitational pull deflects the spacecraft and directs it to the next planet to be visited. The Voyager 2 space probe used a gravity-assist trajectory to visit four planets. The spacecraft visited Jupiter in 1979 and was deflected by its gravitational field toward Saturn, reached in 1980. Saturn in turn directed the probe to Uranus, reached in 1986. Uranus deflected it to Neptune, reached in 1989.

See also **Moon** (How the moon moves); **Planet; Space travel.**

Orbiting observatory. See **Space travel** (Scientific satellites).

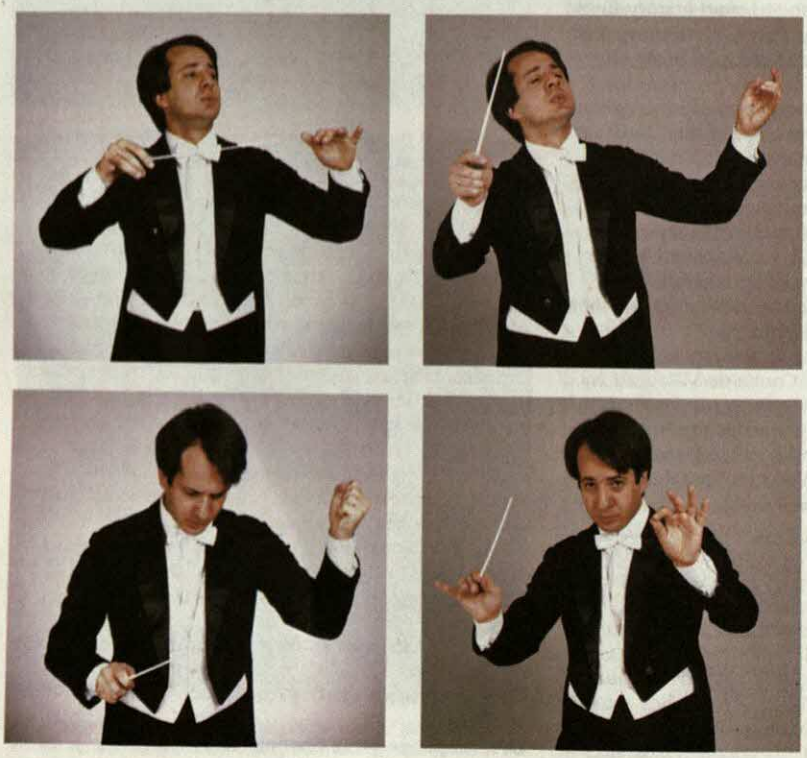
Orchard. See **Fruit; Horticulture.**

Outdoor orchestral concerts attract thousands of music lovers. Such symphony orchestras as the U.S. Philadelphia Orchestra, *left,* perform in city parks and at music festivals.

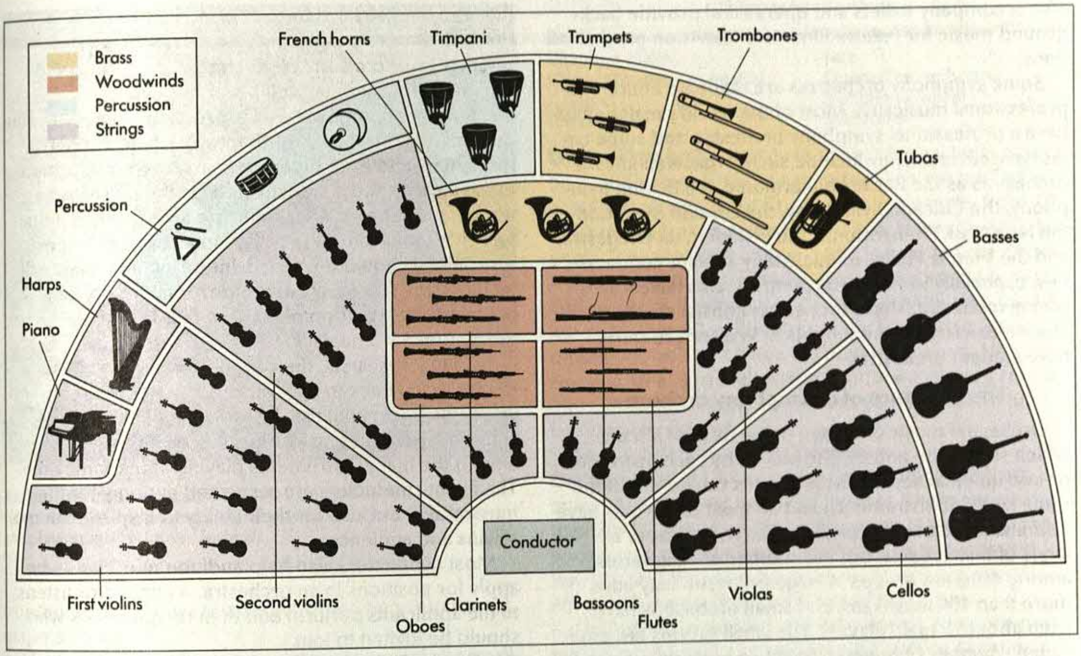
Orchestra is a group of musicians who play together on various instruments. Some African and Asian orchestras consist entirely of percussion instruments, such as drums, gongs, and xylophones. But in most Western nations, a musical group is considered an orchestra only if it includes violins and other stringed instruments. An orchestra differs from a band, which consists chiefly of wind and percussion instruments.

Some orchestras, called *string orchestras,* have only stringed instruments. On the other hand, *dance orchestras* resemble bands in most ways but may include a small string section. The word *orchestra* generally refers to a *symphony orchestra,* which consists mainly of stringed instruments. Symphony orchestras also have woodwind, brass, and percussion instruments, which enable them to produce a full range of musical sounds.

Symphony orchestras play all types of music, but most of them specialize in classical works. An orchestra may perform alone, or it may accompany one or more instrumental or vocal soloists or a chorus. Orchestras



The conductor uses signals and gestures to tell the musicians how to play various parts of a composition. These photographs show how a conductor directs a performance. On the far upper left, he asks the string section to play softly so that a quiet passage by the brass section can be heard. On the far lower left, he signals the orchestra to play vigorously. On the near upper right, he gestures to the musicians to play with expression. On the near lower right, he tells the orchestra to end the composition delicately.



Orchestra seating is designed by the conductor to produce a certain blend of sounds. In this diagram, the strings form a semicircle around the conductor. The woodwind instruments are arranged in the centre, with the percussion and brass sections at the rear.

The orchestra seating shown in the photograph on the left is similar to the arrangement in the diagram above. In both scenes, the strings form a semicircle around the conductor.

Youth orchestras, such as the one on the left, give young musicians an opportunity to gain valuable performing experience.

also accompany ballets and operas and provide background music for feature films and television productions.

Some symphony orchestras are made up entirely of professional musicians. Most of the world's major cities have a professional symphony orchestra, and some cities have several. They include such large, well-known orchestras as the Berlin Philharmonic, the Boston Symphony, the Chicago Symphony, the London Symphony, the New York Philharmonic, the Philadelphia Orchestra, and the Vienna Philharmonic. Many smaller communities, especially in Western countries, also have a symphony orchestra. These orchestras consist chiefly of amateur musicians. Many schools in Western countries have student orchestras.

The structure of a symphony orchestra

Orchestral music is written in the form of a *score,* which shows the notes to be played by each instrument or instrumental section. Most scores call for about the same kinds of instruments, and so most orchestras have a similar structure. A typical orchestra has about 20 kinds of instruments, but the number of each varies among different groups. A large orchestra may have more than 100 musicians, and small orchestras have from about 15 to 40 players. The small groups are often called *chamber orchestras.* During a performance, only the conductor follows the complete score. The printed music used by the musicians shows only their individual parts.

The musicians are divided into four main groups called *sections:* (1) the string section, (2) the woodwind section, (3) the brass section, and (4) the percussion section. The various instruments in the string, woodwind, and brass sections are pitched in different ranges, like the voices in a chorus. In the following discussion, the instruments in each of these sections are listed in order from those of the highest range to those of the lowest. Some percussion instruments are also tuned to definite pitches, but most of them have an indefinite pitch.

The string section is the heart of a symphony orchestra. It has more than half the musicians and consists of from 20 to 32 violins, 8 to 10 violas, 8 to 10 cellos, and 6 to 10 double basses. The violinists are divided into two groups of equal size. The *first violins* play the highest-pitched part in the string section, and the *second violins* play the next highest part. The leading first violinist serves as *leader* of the orchestra. The leader directs the other musicians in tuning their instruments and may also be the orchestra's assistant conductor.

The woodwind section consists chiefly of flutes, oboes, clarinets, and bassoons. An orchestra has from 2 to 4 of each of these instruments. The musicians in the section also play various other woodwind instruments when a score requires them to do so. For example, a *flautist* (flute player) may switch to the piccolo, and an oboe player may double on the English horn.

The brass section consists of 2 to 5 trumpets, 2 to 8 French horns, 2 to 4 trombones, and 1 tuba.

The percussion section includes two or more *timpani,* or kettle drums; bells and cymbals; and a bass drum, gong, snare drum, triangle, and xylophone.

Other instruments are added to an orchestra if a score calls for them. They include such instruments as the harp, harpsichord, organ, piano, and various saxophones.

The conductor directs the musicians by keeping time with the baton or with his or her hands, and by means of gestures and facial expressions. However, conductors do their most important work before a performance—and even before rehearsing a composition. In most cases, the conductor selects the music to be played at a concert. After selecting a work, the conductor's first job is to *interpret* the music by deciding exactly how it should be played. Interpretation of a work includes such elements as tempo, tonal quality, and phrasing. After determining these features of the score, the conductor rehearses the music with the players.

During a rehearsal, the conductor asks individual musicians or sections to play various parts of the score again and again until the desired effect has been achieved. He or she strives for the correct balance among the many instruments playing at the same time. The finest conductors are respected not only for their musical skill but also for their ability to inspire both musicians and audiences.

Most conductors also help audition musicians who apply for positions in an orchestra. A conductor listens to the applicants perform and then recommends who should be invited to join.

Orchestral management. Most major orchestras are private limited companies run by management boards. In some countries, the orchestras have symphony orchestra societies, nonprofitmaking corporations that seek to raise funds for their orchestras, either from public organizations or through business sponsorship. A board of management guides orchestral policy, works with the conductor over musical issues, and has the final word on the employment of musicians. Most professional orchestras have a business manager to handle the budget; prepares employment contracts; plans rehearsal, concert, and recording schedules; and organizes ticket sales and publicity.

History

During the 1500's and early 1600's, Italian instrument makers perfected the violin, viola, cello, and double bass—the main instruments of modern orchestras. The first orchestras made up chiefly of stringed instruments were organized in Italy, France, and Germany during the 1600's. Most of these orchestras also had a few woodwinds. Trumpets and timpani were added for the performance of certain works.

At first, orchestras were used chiefly to accompany vocal works, especially operas and oratorios. But by the early 1700's, a number of European composers were writing pieces for orchestra alone. These composers included Johann Sebastian Bach, Arcangelo Corelli, George Frideric Handel, and Antonio Vivaldi. Their compositions for orchestra were called *concerti, concerti grossi,* and *suites.*

Orchestral works called *symphonies* began to develop in Europe during the mid-1700's. Two composers of the late 1700's, Joseph Haydn and Wolfgang Amadeus Mozart, perfected the symphonic form. Orchestras were enlarged to play these works, and the woodwinds became a major section. In the early 1800's, Ludwig van Beethoven composed the first symphonies that included

An Indonesian orchestra includes double-ended drums and xylophonelike instruments called *gambangs.* These musicians are playing at a religious festival.

trombones. The brass instruments then began to form a major section.

Until the early 1800's, orchestras were generally small enough to perform without a conductor. The leader usually directed the performance. In a concerto, the soloist might do so. By about 1830, however, orchestras had grown so large that nearly all were directed by a conductor. Some composers of the late 1800's and early 1900's wrote works for orchestras of 100 or more musicians. These composers included Anton Bruckner, Gustav Mahler, and Richard Strauss. Since the early 1900's, there has been renewed interest in works for smaller orchestras.

The cost of maintaining an orchestra has increased tremendously during the 1900's. The income from ticket sales pays only a fraction of an orchestra's expenses. Many European orchestras receive additional funds from public sector sources, but many orchestras must depend on private contributions. These gifts rarely keep an orchestra out of debt, and some public funds are used to help support orchestras. State art commissions also contribute supporting funds. However, symphony orchestras may not be able to survive without greatly increased government aid.

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Orchestra bells imitate the effect of real bells of cast bronze. The two types of orchestra bells are tubular chimes and metal bars. The chimes are usually from 2.5 to 5 centimetres in diameter and vary in length with the pitch. They are hung from a metal frame, and are struck with heavy leather-headed mallets. Their sound is deep and resonant. The metal bars are of varying size, usually not more than 13 millimetres in thickness, and are arranged in rows much like the piano keyboard. They are struck with a hard mallet, and produce a ringing sound, more brilliant and higher-pitched than that of the tubular, hanging chimes.

See also **Glockenspiel; Xylophone.**

Orchid is any of an extremely large family of plants, many of which bear beautiful flowers. There are more than 20,000 species of these flowering plants. They are widely cultivated as house, garden, and greenhouse flowers, and they also grow wild. Orchids are *perennials,* which means they live at least three years.

Orchids are colourful and long lasting. They are popular as cut flowers and are given on special occasions. Women sometimes wear them in the form of a *corsage* —a small bouquet pinned to clothing. Australia exports a large quantity of orchids for this market.

Orchids range in size from small plants just over 0.5 centimetre high to vines as much as 30 metres long. The flowers come in all colours except black, and they may be speckled or streaked. Wild orchids grow in all parts of the world except Antarctica. They are most abundant in regions with plentiful rainfall. Most species grow on the trunks and branches of trees, or on rocks, in warm or tropical areas. Wild orchids that live in cooler regions grow on the ground.

Parts of orchids. Like lilies, orchids have three inner petals and three outer, petallike *sepals.* However, unlike lilies, orchids have a central petal that is usually larger and more showy than the other petals. Often, this petal has an unusual shape. It may look like a cup, a scoop, a trumpet, or a bag. The central petal is called the *lip,* or *labellum.* Among most orchids, each flower has one *stamen* (male part) and one *pistil* (female part) at its centre. The stamen bears pollen, which produces sperm cells. The pistil contains egg cells. Among these orchids, the stamen and the pistil are joined, forming a *column.*

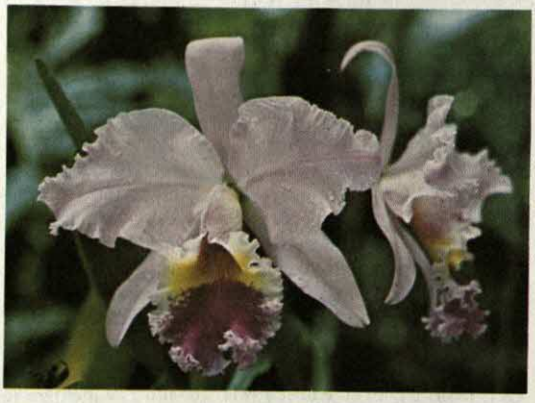
How orchids reproduce. Most orchids reproduce by *cross-pollination.* In this process, an insect, a bat, or a bird carries pollen from the stamen of one flower to the pistil of a flower of another plant. An orchid's fragrance and the size and shape of its blossoms may attract certain types of insects or birds. For example, many orchids look or smell like bees. As a result, bees are attracted to the flowers.

After pollination occurs, sperm cells unite with egg cells in the pistil and seeds develop. Orchid seeds are so tiny that they need the help of certain types of fungi to begin their growth. These fungi supply the seeds with various substances needed for growth.

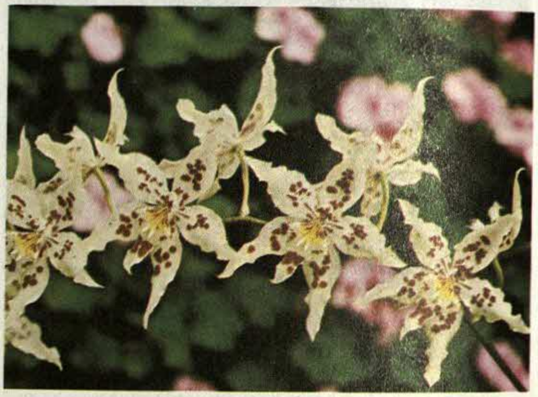
Kinds of orchids. Most botanists divide orchids into

Some kinds of orchids

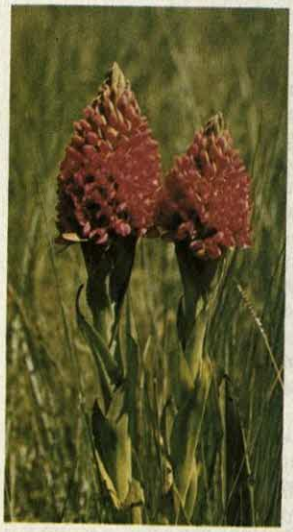
More than 20,000 species of orchids grow in most parts of the world. These beautiful flowers have a wide variety of shapes and colours. Some of the orchids shown below grow in various countries and have no common name in English. The scientific name is given for such flowers.



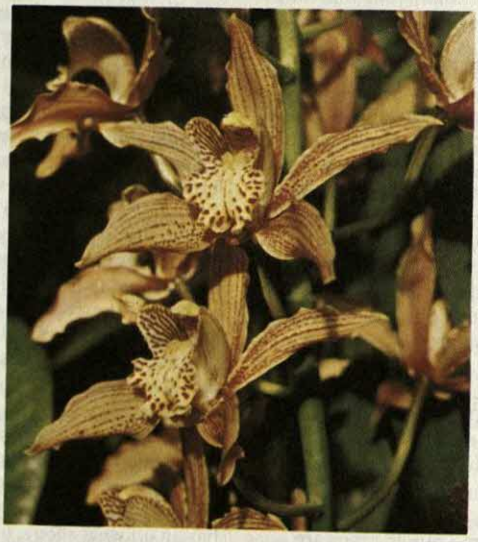
Christmas orchid



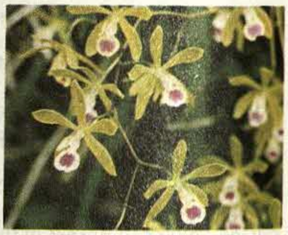
Star orchid



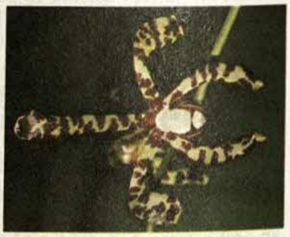
Corcium nigrescens



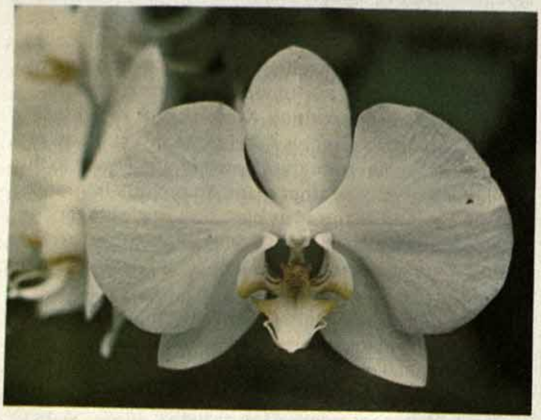
Boat orchid



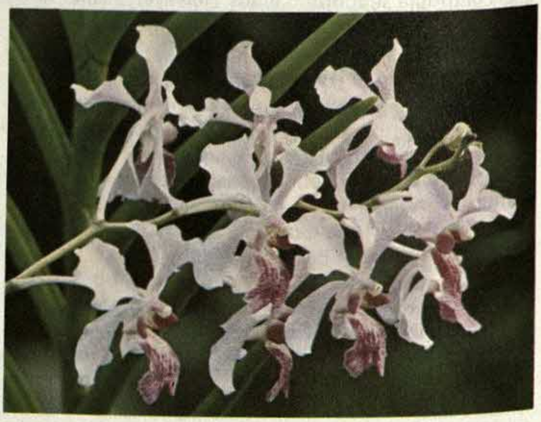
Epidendrum oncidioides



Scorpion orchid



Moth orchid



Semi-terete hybrid orchid

three groups, according to the number of stamens and the form of the column in the flower. The largest group of orchids—more than 96 per cent of all species—have flowers with a completely joined column that typically contains one stamen. This group includes the vinelike *vanilla orchids,* which grow in Mexico and throughout the tropics. Vanilla, a flavouring that is used in many foods and beverages, occurs naturally in these orchids (see **Vanilla**). Species with two stamens almost completely joined in the column make up a group called *lady's-slipper orchids* (see **Lady's slipper**). A third small group consists of orchids with two or three stamens that are at most only partly joined in the column.

Many species of orchids have become endangered due to loss of habitat, especially those growing as *epiphytes* on trees in tropical rainforests.

Scientific classification. Orchids make up the orchid family, Orchidaceae. There are three subfamilies: Orchidoideae, Cypripedioideae, and Apostasioideae.

See also **Flower** (pictures: The fly orchid; Clamshell orchid).

Orcus. See **Pluto.**

Orczy, Baroness (1865-1947), was a Hungarian-born author known chiefly for her adventure-filled novels and detective stories. She also wrote several plays.

Orczy's most famous novel, *The Scarlet Pimpernel* (1905), is set during the French Revolution (1789-1799). The hero, an English aristocrat named Sir Percy Blakeney, appears to be an idle, useless person. But, as the mysterious Scarlet Pimpernel, he gallantly rescues aristocrats who have been sentenced to death. This character also appears in 12 other novels.

Orczy created several detectives in various short stories. For example, the Old Man in the Corner solves baffling crimes as he sits in the corner of a tea shop. He appears in *The Old Man in the Corner* (1909). Another detective, Lady Molly Robertson-Kirk, is featured in *Lady Molly of Scotland Yard* (1910).

Baroness Orczy

Baroness Emmuska Orczy was born in Tarnaörs, Hungary, near Jászberény. Her family moved to London when she was 15. She learned English there and wrote her works in that language.

Ord River, in Western Australia, rises near Halls Creek and flows northward for 480 kilometres into Cambridge Gulf, near Wyndham. Together with its tributaries, it drains an area upstream of the Ord River Dam of 46,200 square kilometres. The Ord is the source of water for a major irrigation scheme, designed to provide water for 75,000 hectares of land devoted to tropical and subtropical crops. About 14,000 hectares have already been developed. The irrigation scheme includes Kununurra Diversion Dam and the Ord River Dam.

The diversion dam, located 100 kilometres from the mouth of the Ord, holds 97,410,000 cubic metres of water. The Ord River Dam, about 48 kilometres farther upstream from the diversion dam, holds 5,679 million cubic metres of water, nine times the volume of water in Sydney Harbour. Water from the Ord River Dam is released as required to the diversion dam, which feeds the irrigation channels.

Farms in the area have grown cotton, rice, grain sorghum, sunflowers, and cattle fodder. Peanuts, maize, mung beans, and soybeans have also been planted.

The Kununurra Diversion Dam was completed in 1968. The Ord River Dam was begun in 1969 and completed in 1972. At that time, planners estimated that the Ord Valley would eventually support 20,000 people. But in the 1970's, farmers in the area encountered a number of major problems, including pests that attacked cotton and a slump in the world demand for beef and agricultural produce. In the early 1980's, the area sown to crops began to increase again, but the world price of sugar declined sharply and a large scale sugar industry became impossible.

Order is a unit of scientific classification. Organisms are divided into seven major groups called kingdoms, phyla, classes, orders, families, genera, and species. Members of an order are more closely related than are members of a class. However, members of orders are not so closely related as are members of families.

See also **Classification, Scientific** (table).

Order in Council. Decrees issued by the British Crown when matters of great importance confront the nation are called Orders in Council. They get this name from the fact that they are proclaimed with the advice of the Privy Council. In 1807, Great Britain issued Orders in Council in answer to Napoleon's threat to blockade the island empire. By these orders, British ships blockaded the European coast and kept neutral trading vessels from entering ports of Napoleonic Europe. See also **Continental System; Privy Council.**

Ordered pair. See **Algebra** (Functions).

Ordnance is a military term used for weapons and ammunition. Most armies, navies, and air forces have ordnance departments. It is the job of the departments to design, make, repair, and distribute weapons and ammunition. The term *ordnance* also includes the tools that are used in the manufacture and maintenance of these items.

See also **Ammunition; Weapon.**

Ordnance Survey (OS) is the official mapping organization of Great Britain. Founded in 1791 under the Board of Ordnance of the British Army, it is now a civilian organization. Its activities include geodetic, topographic, and other surveying and the preparation and publication of maps. Nearly 3,000 staff use the most modern equipment and methods at more than 150 OS offices. The main offices and works of the OS, as well as a public Exhibition Centre, are at Southampton.

The OS offers a wide range of published maps. Urban areas are mapped at a scale of 1:1,250, rural areas at 1:2,500, and mountain and moorland areas at 1:10,000. The wide range of smaller-scale maps derived from these large-scale maps include the all-purpose 1:50,000-scale Landranger maps.

The state mapping authority in Ireland is the Ordnance Survey, based in Dublin. It makes maps and engages in research on place names and in archaeology.

Ordovician Period. See **Earth** (table: Outline of the earth's history).

Öre is a bronze coin used in Sweden. It is worth one-hundredth of a krona.

Øre is a coin used in Denmark and Norway. It is worth one-hundredth of a krone.

Ore is a mineral or a rock that contains enough of a metal to make it worth mining. Often, two or more metals can be obtained from the same ore. Ores naturally occur in beds or veins, mixed in with valueless minerals called the *gangue.*

There are two types of ores—*native metals* and *compound ores.* In *native metals,* the valuable mineral occurs as a pure metal. It is not chemically combined with other substances. Gold, silver, platinum, and copper often occur as native metals. Smelting melts the bands or lumps of pure metal out of the gangue.

In *compound ores,* the valuable metal is joined to other substances such as oxygen, sulphur, carbon, or silicon to form various chemical compounds. The ores of iron, aluminium, and tin are usually found joined with oxygen and form compounds called *oxides.* Copper, lead, zinc, silver, nickel, and mercury are found joined with sulphur and form compounds called *sulphides.* Chemical changes free the metal from the compound. Some metals are freed by electric current in a process called *electrolysis.* Other metals are dissolved out of the ore by acids in a process called *leaching.* See **Metallurgy** (Extractive metallurgy).

See also **Mineral; Rock.**

Oregano. See **Marjoram.**

Oregon, a Pacific Coast state of the United States, is known for its vast forests of evergreen trees. The state leads the nation in timber production. Oregon is known as the *Beaver State* because it supplied thousands of beaver skins during the fur-trading days of the 1800's.

Oregon has a population of 2,853,733. Most of the large cities lie in the rich Willamette Valley of northwestern Oregon. They include Portland, the largest city; Eugene, the second largest; and Salem, the third largest city and state capital.

The Coast Range, Klamath Mountains, and Cascade Mountains rise in the western half of the state. The rugged Columbia Plateau covers much of eastern Oregon. Southeastern Oregon has a basin and range region which extends into California.

Oregon covers 251,419 square kilometres. Its highest elevation, Mount Hood, rises 3,426 metres in the beautiful Cascades. Sea level is the lowest elevation. Temperatures in the state average 0° C in January, and 19° C in July.

Oregon is a Pacific Coast state of the United States. A beautiful state, it is known for its huge forests of evergreens.

Some authorities think Oregon was named after the Columbia River. The mighty river was at one time called the *Ouragon,* which means *hurricane* in French.

Portland is the chief centre of trade and transportation in Oregon. The city has one of the busiest seaports in the United States. The Portland area also has many companies that manufacture electronic products.

Outside Portland, wood processing and farming are the most important economic activities. Oregon's chief farm products include cattle, fruits and vegetables, and wheat. The state's scenic mountains, rivers, and coastline attract many tourists.

Many Indian tribes used to live in the Oregon region. During the 1800's, a series of wars took place between Indian tribes and white people. Among them was the spectacular Modoc War (1872-1873), which ended with the defeat of the Indians.

In the early 1800's, the Oregon region covered a much larger area than it does today. Russia, Spain, Great Britain, and the United States all claimed parts of the region. Oregon's present boundaries were drawn in 1853. It became the 33rd U.S. state on Feb. 14, 1859.

During World War II (1939-1945), Oregon became a major port for shipping military supplies. The state experienced difficult economic conditions during the 1980's, caused largely by a decline in the wood products industry. A decline in the timber supply and increased automation resulted in widespread unemployment.

Oregon grape is the state flower of Oregon, U.S.A. This wild plant, also called the Oregon hollygrape, grows from western Oregon through Washington into British Columbia, Canada. The Oregon grape is a low plant, and does not climb as the wild grape does. Its leaves look like those of the holly, and its wood is yellow. Clusters of dainty yellow flowers open in the early summer. The berries ripen late in the autumn. They look like grapes or blueberries. The berries are often used for jam. Despite its names, the Oregon grape is neither a grape nor a holly. See also **Barberry.**

Scientific classification. The Oregon grape is in the barberry family, Berberidaceae. It is *Mahonia nervosa.*

Oregon Territory was created after the settlement in 1846 of a boundary dispute in what is now the United States between America and Great Britain. It included the present states of Idaho, Oregon, and Washington and part of Montana and Wyoming. Before 1846, the Oregon Country, occupied jointly by the U.S. and Britain, included the area south of Alaska, north of California, and west of the Rocky Mountains. The 1846 settlement gave the United States the land south of the 49th parallel, except for Vancouver Island. The Oregon Country became a territory in 1848. Oregon was admitted to the Union on Feb. 14, 1859.

Oregon Trail was the longest of the great overland routes used in the westward expansion of the United States. It wound 3,200 kilometres through prairies and deserts and across mountains from Independence, Missouri, to the Pacific Northwest. Even today, travellers can see the deeply rutted road cut by wagon wheels along sections of the trail.

Settlers began following the trail to Oregon in 1841. The first large group, about 1,000, used the trail in the "Great Migration" of 1843.

O'Reilly, Bernard (1903-1975), an Australian writer and a well-known bushman, became famous for his books *Green Mountains* (1940) and *Cullenbenbong* (1944). They were published as one book entitled *Green Mountains and Cullenbenbong* in 1949. The book gives an account of an air crash in the McPherson Ranges in 1937. O'Reilly was a member of the search party that found the plane and rescued the survivors. The first part of the book describes the four days of an agonizing search in wild country. The second part tells of the author's family and neighbours and their pioneering history. O'Reilly believed that their pioneering spirit helped the bushmen complete the rescue after others had despaired.

Alfonso Bernard O'Reilly was born in Hartley, New South Wales. He was a member of a pioneer family of the region.

O'Reilly, Bill (1905-1992), known as *Tiger Bill,* was one of the finest bowlers in Australian cricket history. He was a slow to medium bowler who could bowl leg breaks and off breaks with great accuracy and pace. He frequently beat even the world's best batsmen. He could also suddenly decrease his pace and bowl slow deliveries. O'Reilly took 744 wickets in first-class matches—144 of them in Test matches at an average of 22.59 runs each wicket. His best bowling performance was 7 wickets for 54 runs, against England at Trent Bridge in 1934. William Joseph O'Reilly was born in White Cliffs, New South Wales.

O'Reilly, Tony (1936-), became president and chief executive officer of the United States food manufacturer H. J. Heinz Company in 1979. During the 1960's, he won a reputation as a brilliant and successful business executive. He began his career in 1958 as a business consultant. He held top management posts in the Irish Dairy and Sugar Boards before becoming managing director of Erin Foods in 1966. He became joint managing director of Heinz-Erin in 1967.

Anthony John Francis O'Reilly was born and educated in Dublin. He studied law at University College, Dublin. O'Reilly also won fame as an outstanding rugby player. He played for Ireland 29 times in Rugby Union international matches.

Orellana, Francisco de (1511?-1546), a Spanish explorer, headed the first expedition by Europeans to navigate the entire length of the Amazon River in South America.

In March 1541, he joined a Spanish expedition travelling eastward from Quito in what is now Ecuador. The expedition was led by Gonzalo Pizarro, a half brother of the Spanish explorer and conqueror Francisco Pizarro. In December 1541, the Spaniards began to starve and become sick. Orellana and about 55 other men set out by boat on the Amazon River in search of food, but they never returned. Instead, they sailed all the way to the Atlantic Ocean, which they reached in August 1542. Some historians consider Orellana a traitor for abandoning Pizarro. In 1544, Orellana was named governor of the territory he had explored.

Orestes, in Greek mythology, was the son of Agamemnon and Clytemnestra, the rulers of Mycenae, or Argos. Clytemnestra and her lover, Aegisthus, killed Agamemnon after he returned from the Trojan War. Fearing that Orestes was also in danger, his sister Electra sent him from the royal palace.

When Orestes was grown up, the god Apollo ordered him to avenge his father's death by killing Clytemnestra. Orestes returned home and killed his mother and Aegisthus. He then was driven insane by the Furies, the goddesses of vengeance. Orestes finally went to Athens. There, a jury found him innocent of manslaughter and freed him from his guilt and the Furies. Orestes later married Hermione, the daughter of Helen of Troy and Menelaus, the king of Sparta.

See also **Electra; Iphigenia.**

Orff, Carl (1895-1982), was a German composer and music educator. He created his major works for the stage. They combine instrumental music, singing, and gesture and dance into a unified spectacle. Orff's music emphasizes simple, folklike melodies and harmonies. He used percussion instruments to create a powerful rhythmic drive. Orff used Oriental and medieval scales as well as texts in several languages sung simultaneously.

Orff's most popular compositions are three pieces he called *Trionfi* (*triumphs*). The first, *Carmina Burana* (*Songs of Beuron,* 1937), consists of songs set to medieval texts. He used poems by the Roman poet Catullus as texts in *Catulli Carmina* (*Songs of Catullus,* 1943). In *Trionfo di Afrodite* (*The Triumph of Aphrodite,* 1953), Orff adapted texts by Catullus and the ancient Greek writers Sappho and Euripides.

Orff was born in Munich. In 1924, he cofounded a school of gymnastics, music, and dance in Munich. His work at the school reflected his interest in musical education for children. Orff summed up his theories in an influential five-volume book called *Music for Children* (1930-1934, revised 1950-1954).

Organ. See **Human body.**

Organ is a keyboard musical instrument. There are two chief kinds of organs, *pipe organs* and *electronic organs.* Most pipe organs are found in churches, concert halls, and theatres. The history of the pipe organ can be traced back more than 2,000 years. Many masterpieces of music have been composed for it.

The electronic organ was invented in the mid-1900's. Most performers consider the pipe organ superior to the electronic organ. However, electronic organs are popular instruments in the home, and many churches also have them.

Both the pipe organ and the electronic organ have one or more keyboards that resemble a piano keyboard. However, the instruments produce sounds differently. A piano makes sounds by causing steel strings to vibrate. A pipe organ creates sounds by forcing air through metal or wooden tubes called *pipes.* An electronic organ produces sounds by means of electricity.

A pipe organ is the largest and most powerful of all musical instruments. Many pipe organs are so large that they must be built as part of the building where they are to be used. A large pipe organ can produce effects of grandeur that even a symphony orchestra cannot duplicate. It also can play delicate and refined music.

Pipe organs. A small pipe organ has only a few hundred pipes, but a large organ has more than 5,000 pipes.

Most pipes are made of lead or of lead mixed with tin. Some are made of other metals or wood.

An organist creates music by combining the sounds of different *ranks* (rows) of individual pipes. Each pipe in a rank is tuned to a single pitch and produces only one musical tone. Some ranks are pitched one or two octaves higher or lower than others.

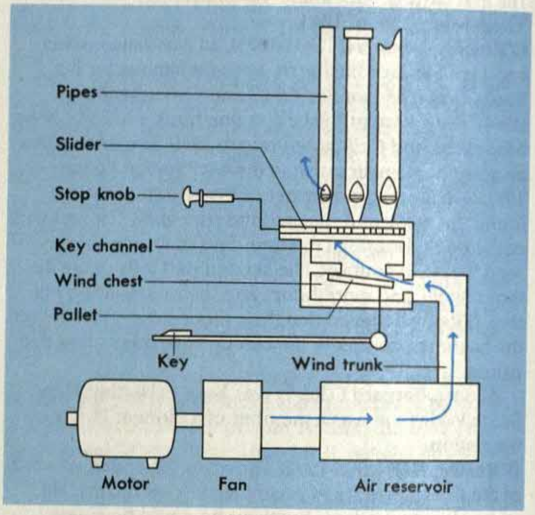
Most organs have two types of pipes—*flue pipes* and *reed pipes.* A flue pipe works like a simple whistle. Air enters from a hole in the bottom of the pipe and causes a column of air inside the pipe to vibrate. The vibration creates the sound. A reed pipe contains a thin brass reed that vibrates as air passes around it.

About 80 per cent of the pipes in an organ are shaped like cylinders. But no two pipes of an organ look or sound exactly alike. The shape and size of the pipe determines the sound it makes. The longest pipes, which produce the lowest notes, may be more than 9 metres long and 30 centimetres in diameter. But most pipes measure less than 1.2 metres long. The smallest pipes, which produce the highest notes, are only 18 centimetres long and less than 6 millimetres in diameter.

Most pipe organs have one, two, or three keyboards. A few have as many as six. The additional keyboards enable the organist to create a wide variety of musical effects. The keyboards played with the hands are called *manuals.* Large organs may have up to five manuals called, in order of importance, the *great organ; swell organ; positive,* or *choir, organ; solo organ;* and *echo organ.* Most organs also have a *pedalboard,* a keyboard played with the feet. Each keyboard—manuals and pedalboard—operates a number of ranks. Every key controls several pipes. All the ranks operated by a keyboard are arranged on a *wind chest,* a box that receives an even flow of *wind* (air) from a reservoir. An electrically powered fan fills the reservoir with wind.

Pipe organs may have several thousand pipes. The pipe organ shown below has four manual keyboards and a pedalboard.

How a pipe organ works



This diagram shows how wind flows through a pipe organ. An electric motor provides power for most modern organs. It operates a fan that forces wind into an air reservoir. The wind moves through a wind trunk into a wind chest. When a key is pressed, a pallet opens and wind enters the key channel. From there a slider, controlled by a stop knob, allows wind to flow into the pipes. As the wind passes through a pipe, it produces a note.

A thin strip of plastic or wood called a *slider* lies under each rank of pipes on a wind chest. A slider has holes in it that match the number and size of the holes in the rank of pipes above it. A slider regulates the passage of wind into the pipes. Sliders are controlled by *stop knobs,* commonly called *stops,* near the manuals. By pulling a stop, the organist moves the slider into position beneath the pipes so that wind can enter them and cause them to vibrate.

To let wind into certain pipes, the organist presses the key that controls those pipes. This action opens a valve called a *pallet* in the wind chest and allows wind to flow into a compartment called the *key channel.* Wind enters the pipes from the key channel.

A cabinet called a *case* encloses all the pipes on a wind chest. It blends the sounds of the pipes and projects this combination of sound out of the organ.

Electronic organs have no pipes. Devices called *oscillators* generate an electric current that produces the tones. The organ's sound is amplified electronically. An electronic organ cannot create the variety and richness of sound that a pipe organ can. But an electronic organ costs less and requires less space. The electronic organ has become a popular instrument in the home. It also is widely used in jazz and rock music.

History. In the 200's B.C., Ctesibius of Alexandria, a Greek engineer, built an organ called a *hydraulis,* or *hydraulus,* that used water power to force air into the pipes. Organs that used a bellows first appeared in Byzantium (now Istanbul, Turkey) during the A.D. 100's and 200's. The major features of the modern organ were developed from the 200's to the 1500's.

From the 1500's to the mid-1700's, many composers wrote organ masterpieces. The greatest of these composers was Johann Sebastian Bach of Germany. Other leading composers included François Couperin of France and Girolamo Frescobaldi of Italy. Organists accompanied singers in operas and oratorios. Small organs were popular at home and public events.

By the late 1700's, small organs had lost their popularity. Many composers believed an orchestra or a piano could provide a wider range of musical effects. By 1900, the organ was still played regularly only in churches as part of religious services.

A revival of interest in the organ began in the early 1900's. The German humanitarian Albert Schweitzer gave organ concerts in many European cities and stimulated new interest in the instrument. In 1934, Laurens Hammond, a U.S. inventor, patented the first commercially practical electronic organ.

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Buxtehude, Dietrich
Franck, César
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Harmonica
Harmonium
Music (Keyboard instruments)

Organ transplant. See **Tissue transplant.**

Organic chemistry is the study of compounds that contain carbon atoms. Carbon atoms are unusual because they can form chemical bonds in many different ways, both with other carbon atoms and with other chemical elements. As a result, many kinds of carbon-containing compounds are possible. Scientists have identified several million organic compounds.

Many simple organic compounds are obtained from plant and animal sources. For example, petroleum and natural gas contain many hydrocarbons from the remains of organisms that lived millions of years ago. Ethanol, a kind of alcohol, is formed by the fermentation of fruit, grains, and vegetables. Other organic compounds present in living matter include amino acids, sugars, and nucleic acids. Inorganic compounds, which generally do not contain carbon, occur chiefly in rocks and minerals.

Scientists once believed that carbon-containing compounds could be obtained only from living sources. However, in 1828, the German chemist Friedrich Wöhler prepared the organic compound urea in his laboratory. Since then, scientists have found many ways of making organic compounds from both organic and inorganic materials, and many important new compounds have been prepared in the laboratory. These compounds include medicines, insecticides, and chains of molecules called *polymers* (see **Polymer**).

See also **Chemistry.**

Organic farming. See **Agriculture** (Special crop-growing methods).

Organization for Economic Cooperation and Development is an association of 25 nations in Western Europe, North America, and the Pacific area. The organization, called the OECD, works to promote the economic and social welfare of its members, and coordinates their efforts to aid developing countries.

Members of the OECD

Countries that became members of the OECD in 1961 do not have dates after their names. Other nations are listed with their years of admission.

Australia (1971)
Austria
Belgium
Canada
Denmark
Finland (1969)
France
Germany
Greece
Iceland
Ireland
Italy
Japan (1964)
Luxembourg
Mexico (1994)
Netherlands
New Zealand (1973)
Norway
Portugal
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The Council of the OECD consists of one representative for each member nation. The OECD has headquarters in Paris. It was established in 1961 to succeed the Organization for European Economic Cooperation (OEEC). Seventeen European nations formed the OEEC in 1948 as a result of the Marshall Plan. Under the Marshall Plan, the United States helped Europe achieve economic recovery after World War II (1939-1945).

See also **International Energy Agency.**

Organization of African Unity (OAU) is an association of African nations. It works to promote unity among African peoples and strengthen cultural, economic, military, scientific, and social ties. It also aids member nations that are stricken by natural disasters. The OAU consists of 52 countries and a government-in-exile (see table).

The OAU opposes colonialism and believes all Africa should be independent of any non-African rule. The organization campaigned for majority rule for South Africa, which came about in 1994. Although it is the policy of the OAU to support majority rule in other countries, most OAU members are themselves ruled by military or one-party dictatorships.

Members of the OAU

The original members of the OAU do not have dates after their names. Other members are listed with their years of admission. One original member, Morocco, resigned in 1984.

Algeria
Angola (1975)
Benin
Botswana (1966)
Burkina Faso
Burundi
Cameroon
Cape Verde (1975)
Central African Republic
Chad
Comoros (1975)
Congo
Djibouti (1977)
Egypt
Equatorial Guinea (1968)
Eritrea (1993)
Ethiopia
Gabon
Gambia (1965)
Ghana
Guinea
Guinea-Bissau (1974)
Ivory Coast
Kenya (1963)
Lesotho (1966)
Liberia
Libya
Madagascar
Malawi (1964)
Mali
Mauritania
Mauritius (1968)
Mozambique (1975)
Namibia (1990)
Niger
Nigeria
Rwanda
Saharawi Arab Democratic Republic (1984)*
São Tomé and Príncipe (1975)
Senegal
Seychelles (1976)
Sierra Leone
Somalia
South Africa (1994)
Sudan
Swaziland (1968)
Tanzania
Togo
Tunisia
Uganda
Zaire
Zambia (1964)
Zimbabwe (1980)

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*The Saharawi Arab Democratic Republic is a government-in-exile that was formed by the Polisario Front, an organization seeking independence for the northwest African territory of Western Sahara.

The OAU was founded in 1963 in Addis Ababa, Ethiopia, and originally had 32 members. Through the years, its influence has increased in both African and world affairs. The OAU has settled several boundary disputes between various member nations. It established a special fund to aid independence movements against colonial rule in Africa. Such movements helped end Portuguese colonial rule there (see **Portugal** [History]). The OAU also supported a successful movement by blacks in Zimbabwe (formerly Rhodesia) to gain control of their government. The members also tried to expel South Africa from the United Nations. Their attempts ended only after blacks gained majority rule in 1994. The organization does not have authority to force its members to follow its policies.

The OAU has three administrative bodies: the Assembly of the Heads of States and Governments, the Council of Ministers, and the General Secretariat—which is headed by a secretary-general. The assembly holds an annual meeting attended by the leader of each member nation. The leaders vote on policies recommended by the council, which consists of foreign ministers or other officials appointed by the individual governments. The council meets at least twice a year. The General Secretariat, a permanent body located in Addis Ababa, works to make sure that the OAU's policies are carried out. In addition, there are a number of specialized agencies.

The OAU's problems include disputes over the membership of nations, shortages of funds, costs of dealing with natural disasters, and disputes over the appointment and functions of the secretary-general.

Organization of American States (OAS) is an association of 35 American countries. The OAS seeks to provide for collective self-defence, regional cooperation, and the peaceful settlement of controversies. The group's guiding principles include a belief in the value of international law, social justice, economic cooperation, and the equality of all people. The OAS charter also states that an act of aggression against one American nation is regarded as an act of aggression against all the nations.

Major OAS policies are formed at annual sessions of the *General Assembly.* All member nations can attend, and each has one vote. Special *Meetings of Consultation of Ministers of Foreign Affairs* deal with urgent problems, especially those relating to defence or the maintenance of peace in the Americas. The *Permanent Council,* with headquarters in Washington, D.C., is the executive body of the OAS. Each member nation is represented. The council supervises the *General Secretariat,* makes plans for General Assembly sessions, and oversees OAS administration. The secretary-general, the chief administrator of the OAS, is elected to a five-year term by the General Assembly.

In 1962, the OAS voted to exclude Cuba's Communist government from active membership of the OAS. Cuba remains a member but its government cannot participate in the organization's activities.

In 1965, a revolt in the Dominican Republic led the OAS to set up its first military force. Troops from six Latin-American countries and the United States took part. The troops and OAS committees worked to restore order in the Dominican Republic. In 1969, the OAS acted quickly to end a five-day invasion of Honduras by troops from El Salvador.

During the late 1970's, the Inter-American Human Rights Commission—a specialized OAS agency—investigated human-rights violations. It also issued reports about electoral fraud, illegal imprisonment, and torture and other acts of brutality.

The influence of the OAS began to decline during the early 1980's because of increased involvement by other international agencies in Latin-American affairs. These agencies included the International Monetary Fund and the World Bank. Canada joined the OAS in 1990.

See also **Latin America** (History); **Pan-American conferences; Flag** (picture: Flags of world organizations).

Members of the OAS

Countries are listed with the years they became OAS members.

Antigua and Barbuda (1981)
Argentina (1956)
Bahamas (1982)
Barbados (1967)
Belize (1991)
Bolivia (1950)
Brazil (1950
Canada (1990)
Chile (1953)
Colombia (1951)
Costa Rica (1948)
Cuba (1952)
Dominica (1979)
Dominican Republic (1949)
Ecuador (1950)
El Salvador (1950)
Grenada (1975)
Guatemala (1955)
Guyana (1991)
Haiti (1950)
Honduras (1950)
Jamaica (1969)
Mexico (1948)
Nicaragua (1950)
Panama (1951)
Paraguay (1950)
Peru (1952)
St. Christopher and Nevis (1984)
St. Lucia (1979)
St. Vincent and the Grenadines (1981)
Suriname (1977)
Trinidad and Tobago (1967)
United States (1951)
Uruguay (1955)
Venezuela (1951)

Organization of the Islamic Conference (OIC) is an international organization of Muslim countries based in Jidda, Saudi Arabia. It promotes the interests of member nations and aims to establish closer links between them. There are 46 countries in the OIC. Among them are Afghanistan, Bangladesh, Burkina Faso, Egypt, Indonesia, Iran, Iraq, Libya, Malaysia, Morocco, Niger, Pakistan, Saudi Arabia, and the United Arab Emirates.

One of the OIC's main goals is to promote Islamic *solidarity* (unity) and cooperation in economics, politics, culture and science. Another of its goals is to try to eliminate ethnic discrimination and segregation and all forms of colonialism. It also aims to take measures founded on justice to support international peace and security; to coordinate efforts to protect Islam's holy places; and to support the struggle of the Palestinians for self-determination in a land of their own. The OIC also supports Muslims in their struggle to protect their dignity, independence, and national rights, and helps to promote cooperation and understanding among OIC states and other countries.

The OIC was established in May 1971, following a summit meeting of Muslim national leaders in Rabat, Morocco, in September 1969, and two meetings of foreign ministers in 1970.

See also **Islam.**

Organization of Petroleum Exporting Countries (OPEC) is an association of 12 nations that depend heavily on oil exports for their incomes. The members of OPEC work together to try to increase their revenue from the sale of oil on the world market. OPEC members have between two-thirds and three-quarters of the world's recoverable oil reserves. In the early 1990's, these countries produced more than half of the oil traded internationally. The members of OPEC are Al-

Orienteering is a sport that requires skill in map reading. Here, a competitor studies his map at a control point.

geria, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

OPEC was founded in 1960 by Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela. At that time, the petroleum industry in these countries was controlled by United States and European oil companies. These firms paid the host governments income taxes and *royalties* (shares of their profits) based on the *posted price* the companies charged for crude oil on the world market. In 1959 and 1960, oil production greatly exceeded world demand. Several of the major companies cut the posted price and thus their payments to host governments. OPEC was founded in response to this price cut, as oil-producing nations sought to gain more control over oil pricing and production arrangements.

OPEC had little influence on oil prices during the 1960's, when production kept pace with demand. In the 1970's, however, world demand for oil began to outstrip the available non-OPEC supply, and led members of OPEC to raise their prices dramatically.

OPEC was less successful at achieving its goals in the 1980's, when the world oil supply again exceeded demand. In 1983, OPEC cut the price of its oil for the first time. During the middle and late 1980's, OPEC set production limits for its members several times. But many OPEC members ignored the limits, which held prices down.

O'Riada, Sean (1931-1971), was an Irish musician and composer. He wrote many kinds of music, including film scores and choral works. He was greatly influenced by traditional Irish music.

Sean O'Riada was born in Cork. He studied classics and music at University College, Cork. After working for Radió Éireann, he continued his musical studies in Paris and Italy. On his return, he became director of music at the Abbey Theatre in Dublin. In 1959, O'Riada wrote music for the film *Miss Éire,* which included the lament "Roisin Dubh." He grew increasingly interested in Irish folk music, and in 1961 formed a band to play traditional music. His own compositions include a setting of the Roman Catholic mass and music for the film *The Playboy of the Western World* (1961).

Orient is another name for the Asian countries and islands, or the East. Sometimes the term is used to mean only the eastern part of Asia, which is also called the *Far East.* See also **Far East; Asia.**

Oriental rug. See **Rugs and carpets.**

Orienteering is a sport in which competitors travel on foot from point to point, using maps and compasses.

Types of orienteering. There are several types of competitions.

Cross country. Competitors are required to check in at a set number of control points in sequence.

Score orienteering uses control points scattered around the area. No competitor could call in at every one in the prescribed time. For this reason, checking in at difficult and distant control points earns a competitor more credit than checking in at nearer and easier ones.

Line orienteering requires competitors to find the control points by following the line and marking each control point on their maps.

Relay orienteering is carried out between teams of three or more, with each runner completing a basic cross-country course of seven or eight control points. The second runner of each team starts as the first finishes, and subsequent runners as the previous runner finishes.

Origami is the art of folding paper into decorative objects. The term is the Japanese word for *folded paper.* There are about 100 traditional origami figures, most depicting such natural forms as birds, flowers, and fish. An abstract, ceremonial form of origami, called a *noshi,* is a pleated paper ornament attached to gifts. Most origami is folded from an uncut square of paper. The most com-

Origami is the Japanese art of folding paper into decorative objects. Most figures can be made without cutting or pasting.

mon sizes of square are 15 centimetres and 25 centimetres. The preferred paper is thin Japanese paper called *washi,* but foil-backed wrapping paper and heavy art paper are also used.

Historians believe that origami, like paper, originated in China. However, it was in Japan that the art flourished. Since the 1940's, origami has reached new levels of complexity and realism, with hundreds of new figures created each year.

Origin of Species. See **Darwin, Charles R.; Evolution** (Darwin's Theory).

Orinoco River is a South American river 2,066 kilometres long. It has two known sources, both in the Parima highlands in Venezuela, near the boundary of Brazil. It flows northwest to Colombia and forms the boundary between Colombia and Venezuela. Then it swings eastward. About 180 kilometres before it reaches the seacoast, it divides into many channels. For location, see **Venezuela** (terrain map).

Small oceangoing vessels can sail 418 kilometres upstream from the mouth of the Orinoco. Ships can use the river for about 800 kilometres above the Maipures and Atures rapids. Ciudad Bolívar is the centre of the Orinoco river trade. Steamships run between Trinidad and Ciudad Bolívar most of the year. Major branches of the Orinoco are the Apure, Caroní, and Meta rivers. Including its tributaries, the Orinoco has a navigable length of 6,920 kilometres.

Oriole is the name of two different groups of woodland birds that have bright plumage, mainly yellow and black or red and black. Old World orioles usually nest high up in the trees, the nest slung between a forked branch. Or, they tend to nest in holes in trees. An oriole's call is a loud, flute-like whistle. Orioles eat fruit and insects. The golden oriole nests in Europe and winters in Africa. American orioles belong to the blackbird family. See **Blackbird.**

Scientific classification. Old World orioles belong to the family Oriolidae. The European oriole is *Oriolus oriolus.* American orioles belong to the family Icteridae.

See also **Baltimore oriole.**

The golden oriole breeds in Europe. It builds its nest between a forked branch, and generally feeds high up in trees.

Orion, the Hunter, is a brilliant constellation that includes two of the brightest stars in the sky. Orion is often pictured with his back turned toward us. In this view, the bright red star, Betelgeuse, marks his left shoulder. A blue-white star called Rigel marks his right foot. Two fainter stars, Bellatrix and Saiph, mark Orion's right shoulder and left foot. Orion is easily identified by a row of three stars forming his belt. A sword, made up of a row of faint stars, dangles from the belt.

Two *nebulae* (clouds of gas and dust) are located in Orion. The Great Nebula in Orion lies in the middle of his sword. This nebula is visible as a misty spot under a dark sky. The Horsehead Nebula in Orion's belt is very difficult to see.

See also **Astronomy** (picture: The Horsehead Nebula in the constellation Orion; maps); **Betelgeuse; Nebula** (picture); **Rigel; Star.**

Orion was a handsome and energetic hunter in Greek mythology. He was a giant with the power to walk through the sea and on its surface.

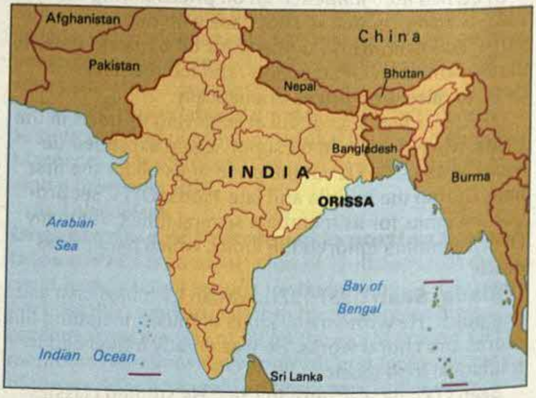
Orion had a troubled love life. His wife was sent to Hades after she boasted that she was more beautiful than the goddess Hera (see **Hades**). Because Orion seduced his fiancée, Merope, her father, King Oenopion, blinded him. Helios, the sun god, restored Orion's sight.

According to one myth, Artemis, the goddess of hunting, killed Orion because he tried to rape her. Another myth says that Artemis considered marrying Orion, but her jealous brother Apollo tricked her into hitting Orion with an arrow while he was swimming. In her sorrow at his death, Artemis placed Orion in the sky as a constellation. Another myth tells that Gaea, the earth, sent a scorpion to sting Orion to death.

Orissa is a state on the northeastern coast of India. It receives few visitors despite the fame of the Sun Temple at Konarak and the Jagannath Temple in Puri. The capital of the state of Orissa, Bhubaneswar, has some of the finest temples in India, dating from the 600's.

People and government

People. For Orissa's total population, see the *Facts in brief* table with this article. Orissa is one of the least densely populated states of India. About a quarter of the population are tribal and live mainly in the inland dis-



Orissa is a state of India on the northeastern coast. It is a land of forests, fields, and small villages.

Puri is one of Orissa's largest cities. Puri is the site of the Jagannath Hindu Temple. Jagannath, "Lord of the Universe", is a form of the god Krishna, or Vishnu.

tricts. Orissa is one of the major Hindu states in India. About 97 per cent of the population are Hindus. The majority speak Oriya, an Indo-European language, but there are also many minor languages and dialects.

There are about 60 *adivasi* (ancient inhabitants) or tribal groups living in forest and remote hill regions of the state. Some of them have remained almost untouched by modern civilization. Each group has its own language, social customs, and artistic, music, and dance traditions. Several groups still use bows and arrows to hunt (hunting is a main source of food) and to defend themselves against enemies.

The Kondhs, who live mostly in the western districts, used to carry out human sacrifice. Today, they have replaced this with animal sacrifice, which they perform at the time of sowing seeds. The aim of the sacrifice is to ensure a good crop. The Bondas live in the Khairaput block of the Malkangiri district. They live in the remoter high hills and grow rice in forest clearings. The Santhals come from the northern districts of Mayurbhanji and Balasore. Their language is one of the oldest in India. In the northwestern industrial belt, people have abandoned their aboriginal lifestyle to work in the steel mills in that region.

Despite rapid industrial growth, Orissa is one of the least urbanized states in India. Nearly 90 per cent of the people live in rural areas. Bhubaneswar, the capital, is the state's largest city.

Government. Orissa took its present form in 1949. It has 21 elected members in the *Lok Sabha* (lower house) and 10 elected representatives in the *Rajya Sabha* (upper house) of the Indian national parliament. Orissa has only one legislative chamber, its state legislative assembly. It has 147 seats. There are 27 administrative districts.

Economy

Agriculture. The traditional farming method in Orissa was *shifting cultivation.* The farmers made clearings in the forest, cultivated them for a few years, and then left them to recover their natural fertility. Even as recently as the 1960's, shifting cultivators removed more than 3 million hectares of forest every year. Since then, settled farming in the hills has developed extensively. Rice and millet dominate farming in the interior of Orrisa. Rice is grown on 90 per cent of the fertile plains of the Mahanadi Delta. There are also small areas of *gram* (lentils), jute, oilseeds, and *ragi* (a grain crop).

Forests cover about 40 per cent of the state. The main forest products are *sal* (a timber tree), teak, medicinal plants, and *lac* (a resin used for varnishes).

Manufacturing. Since the early 1980's, there have been major developments in industry in Orissa. Aluminium smelting plants use local *bauxite* (aluminium-bearing ore) and hydroelectricity. There is a steelworks at Rourkela. Some of the development has taken place with the help of overseas aid. Despite recent growth, Orissa still provides only 3 per cent of India's factory employment. The Industrial Development Corporation in Orissa organizes cable works, cement works, spinning and textile mills, and the steelworks.

Local crafts. Various traditional crafts operate on a commercial basis. Craftworkers carve delicate images, bowls, and plates out of soft soapstone, hard konchila

Facts in brief about Orissa

Population: *1991 census*—31,512,070.
Area: 155,707 km².
Capital city: Bhubaneswar.
Largest cities: Bhubaneswar, Cuttack, Berhampur, Puri, Sambalpur.
Chief products: *Agriculture*—millet, rice. *Manufacturing*—aluminium, fertilizer, paper, steel, textiles. *Mining*—bauxite, coal, iron ore.

The Mukteswar Temple is one of a group of ancient, ornate Hindu temples at Bhubaneswar, in Orissa. Built in the late 900's, it has intricate sculptures and architectural ornamentation carved in fine detail.

stone, or multi-coloured serpentine stone from Khiching. In Parlakhemundi and Cuttack, people carve buffalo horn into small, flat figures of animals and birds.

Silver filigree is the most famous work of the Cuttack jewellers. They turn fine silver wire into intricate objects such as small boxes and trays with floral patterns. The tribal metal casting in the *dhokra* style by the *lost wax process* flourishes in the Mayurbhanj district. Metal workers place a clay shell around a wax core and pour a molten metal into the shape. The wax melts away and the metal fills the space.

Other traditional crafts include wood carving, inlay of ivory on wood, and the making of papier-mâché masks. Picture makers, particularly from the village of Raghurajpur near Puri, paint *pattachitras* on specially prepared cloth. They coat the cloth with earth to stiffen it and finish it with lacquer after painting.

People in Baripada town take part in the Holi Festival to celebrate the end of winter.

Textile weaving has been a traditional handicraft throughout Orissa for generations. Thousands of people work in this cottage industry. The favourite designs include rows of flowers, birds, animals (particularly elephants), and geometric shapes, using either *tussore* (silk) or cotton yarn. Colourful appliqué work, decorating embroidered cloth for use in temples, is done near Puri. Roadside shops sell items for the house and garden, such as sun umbrellas and cushion covers.

Another skill that is still practised is *palm leaf etching.* A sharp iron "pen" is held motionless against the hard leaf of the palmyra palm. Moving the leaf produces lines upon it. This was the way in which early books were produced, and helped to give the Oriya script its rounded form. Beautifully illustrated manuscripts are still produced in this way.

Mining. The ancient rocks of inland Orissa contain some of India's richest mineral resources. The proven reserves of coal are estimated at about 44,305 million metric tons. There are thick seams of coal in the mines at Talcher, 100 kilometres to the northwest of Bhubaneswar. Around Bhubaneswar, and at several other sites in the interior, there are important bauxite deposits. Bauxite mining began there in the 1980's.

Orissa also has reserves of dolomite, iron ore, manganese, and limestone. The far north of the state, especially between Keonjihar and Rourkela, has enormous reserves of high-grade iron. There are also important reserves of chromite, graphite, ilmenite, and mica.

Mining began only after independence in 1947. A new port at Paradwip handles mineral exports.

Transportation and communication. Orissa has well above the national average length of roads per square kilometre. National highways run down the old coast road and across the north of the state, as part of the link between Calcutta and Bombay. The rail network is less extensive. Parts of the interior remain remote. Some of the hills in the southwest are still forested, and few roads have been developed.

In the early 1990's about half of Orissa's villages had television and 90 per cent had radio. Although there are regional as well as national newspapers, less than 1 per cent of the population read a daily newspaper.

Land

Location and description. Orissa is bounded by West Bengal and Bihar to the north, Madhya Pradesh to the west, and Andhra Pradesh to the south. To the southeast lies the Bay of Bengal. The whole of the state is south of the Tropic of Cancer, and midway between the semitropical, wet deltas of Bengal and the much drier tropical interior of the Peninsula.

In the far north is the ancient, volcanic Simlipal Massif. It rises to a height of more than 1,000 metres from the surrounding plateau and is a continuation of the Chota Nagpur region. In the south, a series of hills known as the Eastern Ghats rises to heights of 1,500 metres. Also in the south of the state are the beautiful lakes of Khairaput. Between these two regions are gently rolling plains.

Down the east coast runs a flat alluvial plain, with the Mahanadi Delta at the centre. Occasional low mounds of granite, such as the hill at Dhauli, break the otherwise straight horizon. The delta stretches nearly 170 kilometres from its northernmost point southward to the Chilika Lake. In many places, the delta is more than 80 kilometres wide. The Hirakund Dam, one of the largest in Asia, controls the Mahanadi River, which used to do great damage during the flood season. There is a huge reservoir behind the dam. The Hirakund Dam Project is a multipurpose river valley project to provide irrigation, power generation, flood control, and navigation.

The natural vegetation of the highlands of Orissa is dense, deciduous forest. The forest area decreased greatly in the 1980's due to extensive felling of trees and the clearing of land for cultivation.

Because great areas of forest have been settled by farmers, the habitat of bison, elephants, tigers, and other large animals that were once widespread has been reduced. They are now largely confined to the game reserves. In the Simlipal region there are still *chital* (spotted deer), flying squirrels, *gaur* (wild ox), leopard, *sambar* (large deer), and wolves. There is also a variety of wild fowl including mynas, parakeets, and peacocks.

Rivers and lakes. Most rivers flow southeast through the state from the peninsular plateau to the Bay of Bengal. The Mahanadi and the Brahmani are two of the larger ones. They rise in the forested hills and enter the sea across the Mahanadi Delta. Other important rivers are the Subarnarekha, the Rushikulya, and the Tel. There are several artificially created and natural lakes in the hills of the interior. Lake Chilika is the largest coastal lagoon in India. It varies in size from 900 to 1,200 square kilometres. Water in the lagoon alternates between being salty and being fresh. It is only a few metres deep, and very rich in marine and bird life.

Climate. Temperatures vary according to altitude. On the plains around Bhubaneswar, just south of the Tropic of Cancer, the average maximum temperature in December, the coldest month, is 28° C, and minimum temperatures do not fall below 16° C. In April and May, the hottest months, maximum temperatures soar to 38° C. The average minimum temperature from April to September is between 25° C and 27° C.

Annual rainfall along the coast decreases southward from nearly 160 centimetres at Balasore to just over 110 centimetres at Chatrapur. But the inland hills in the far southwest receive much more rain than the nearby coastal strip. The major part of Orissa has one of the shortest dry seasons in India with only January and February being rainless.

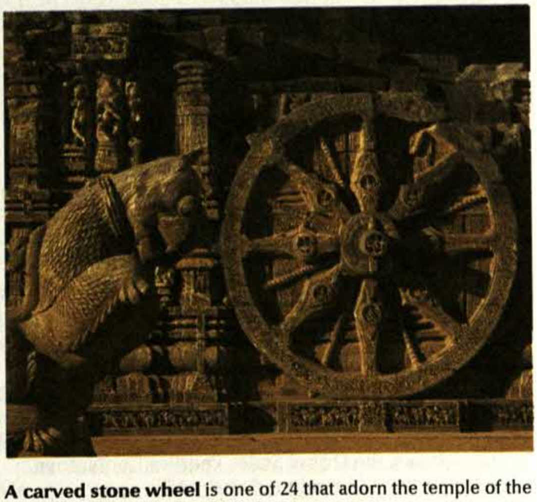
History

Orissa, a part of the ancient kingdom of Kalinga, first grew prosperous through trade. Kalinganagar port developed as early as 300 B.C. Java, Sumatra, Borneo, and Bali all established relations with the Kalinga kings.

The Maurya king Asoka conquered and annexed the Kalingan kingdom in about 260 B.C. (see **Asoka**). Orissa regained its independence in about 100 B.C. under the local king Kharavela. He was a Jain, and perhaps the greatest of the Kalinga kings. His achievements in extending his empire and descriptions of his capital are recorded in an inscription in the Udayagiri caves near Bhubaneswar. His exploits included military expeditions in which he defeated the king of the Deccan.

After Kharavela, two separate areas in the north and centre of the Orissa region developed. Their names were Utkal (a land where the arts excelled) and Toshali. During this time, sea trade flourished, and Buddhism once again became a popular religion.

Two dynasties had a major effect upon the history of Orissa. The rule of the Kesaris (A.D. 600-1076) and the Gangas (1076-1435) saw the development of a style of temple architecture often referred to as Indo-Aryan. The temples in and around Bhubaneswar were built by the kings of the Kesari dynasty. The founder of the Ganga dynasty, Choda Ganga (ruled 1076-1148), was a devout Hindu and a patron of art and literature. He built the great temple of Jagannath at Puri. The most famous ruler of the Ganga dynasty was Narasimha I (ruled 1238-1264). He was responsible for the construction of the temple of the Sun God at Konarak.



A carved stone wheel is one of 24 that adorn the temple of the sun god, Surya, at Konarak, in Orissa.

Orissan fishermen land their catch with the help of their families. Their unique fishing boats are made of a few heavy, solid timber planks lashed together.

The Gangas became rich through trade and commerce and used their wealth to finance their temple-building. By the early 1400's, their power was already starting to decline. A Solar dynasty took control in 1435 and ruled Orissa until 1542.

During medieval times, Orissa had been powerful enough and remote enough to resist the Muslim invasions from the north in the 1200's. But for a time the Afghans held Orissa in the 1500's, and the powerful Mughals arrived as conquerors in 1592. The Mughal emperor Akbar annexed it in that year. With the decline of the Mughals in the 1700's, the Marathas occupied Orissa for a time until the British took it over.

In 1765, after the victory of the British military leader Robert Clive at Plassey, the East India Company acquired parts of Orissa. Cuttack and Puri came under British control in 1803. Many interior areas remained under princely rule, subject to the paramount authority of Britain (the United Kingdom), until India gained its independence in 1947.

During British rule, several revolts took place in Orissa. The significant ones included the Paik Rebellion of 1817, the Ghumsar risings of 1836-1856, and Sambhalpur revolt of 1857-1864. These uprisings were put down by the British administration but promoted growth of anti-colonial consciousness in Orissa.

After the British conquest of India, the Oriya-speaking areas were placed under different administrative units known as the Bengal Presidency, the Madras Presidency, and the Central Provinces. In the late 1800's, there began a movement to amalgamate all Oriya-speaking areas into one administrative unit. This movement—the Utkal Union Movement—was an early expression of political nationalism in Orissa. It succeeded in securing the setting up of a separate province of Orissa in 1936.

Along with the Utkal Union Movement, the wider struggle for the freedom of all India also became popular in Orissa. The Swadeshi, the Non-cooperation, the Civil Disobedience, and the Quit India movements all won wide and vigorous support in this region. In the princely states, the Orissa States Peoples Conference, founded in 1931, campaigned against the oppression of feudal rulers and on behalf of democratic rights.

At the time of independence in 1947, all the princely states chose to be part of the Indian union. In Orissa, Congress became the dominant party and was in power for a long period. In 1991, Janata Dal became the ruling party in Orissa.

Related articles in *World Book* include:

Asoka
Bhubaneswar
India
India, Government of
India, History of
Jagannath
Kalinga, Conquest of
Maurya Empire

Orizaba, Pico de, is the highest mountain in Mexico and the third highest in North America. Only Mount McKinley in the United States and Mount Logan in Canada are higher.

Pico de Orizaba rises 5,611 metres above sea level. Its Aztec name, Citlaltépetl, means "mountain of the star." The mountain stands about 48 kilometres north of Orizaba, a resort and cotton-milling city in southeastern Mexico. Pico de Orizaba is a volcanic mountain, part of Mexico's Neo-Volcanic Chain. The volcano last erupted in the late 1600's.

See also **Mountain** (diagram: Major mountains).

Orkney is a group of 67 islands and many islets lying off the northern coast of Scotland. Some 21 of the Orkney Islands, are inhabited. The largest island, Mainland, has most of the population including the towns of Kirkwall and Stromness.

The people of Orkney are called *Orcadians*. They are descended from Scots and Norse settlers. The only towns are Kirkwall and Stromness, both of which are on Mainland.

Education. There are primary schools throughout the islands. Most such schools are small. There are two comprehensive secondary schools located at Kirkwall and Stromness.

Local government. Orkney is administered by an island authority set up in 1975.

Agriculture and fishing. Orcadian hill-farmers grow mainly grass, barley, and root-crops. Many farmers keep cattle or sheep and export thousands of each every year. They also export cheese. Local fishing crews catch mainly shellfish. These include crabs, lobsters, mussels, prawns, and scallops. Fish farming, especially of salmon, is also important.

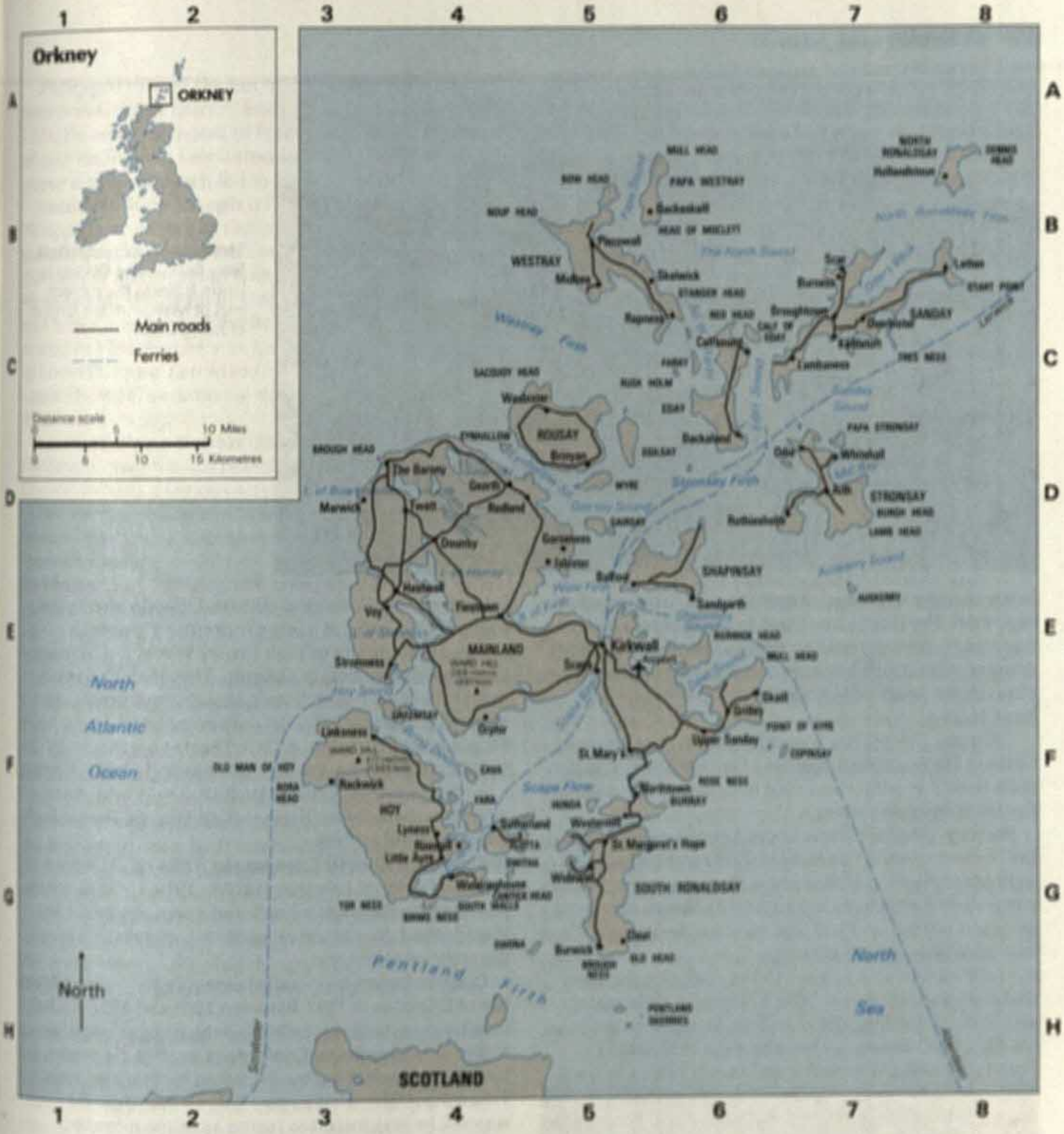
Manufacturing. Craft industries thrive on Orkney, including jewellery manufacturing and wood carving for furniture. Many women work at home, knitting on machines. The islands have two whisky distilleries.

Mineral resources. Oil is important to Orkney's economy. One of the richest fields in the North Sea lies east of Orkney. Flotta has an oil terminal. There are low-grade deposits of uranium oxide.

Transportation and communication. Regular air and sea services link many of the islands. Ferries connect Kirkwall with Aberdeen and the Shetlands, and

Facts in brief about Orkney

Administrative centre: Kirkwall.
Largest town: Kirkwall.
Area: 975 km^2.
Population: *1991 census*—19,450.
Chief products: Beef, cheese, fish, jewellery, petroleum, whisky.



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Stromness with Scrabster, near Thurso, on the mainland of Scotland. Regular air services connect the airport near Kirkwall with several British cities. Local radio stations broadcast to the islands from Kirkwall and Lerwick.

Things to see and do. The Orkney coasts have magnificent cliff scenery and a rich variety of wildlife. St. John's Head, in Hoy, has a cliff that rises about 300 metres high.

There are many archaeological remains on the islands. Maeshowe, a burial chamber, and Skara Brae, a well-preserved village, date from 3000 B.C. or even earlier. Earl's Palace in Kirkwall has interesting architecture. Cultural events include the St. Magnus Festival.

The land. Orkney is about 10 kilometres from the Scottish mainland at its most southerly point. The islands extend for 80 kilometres north to south and for 64 kilometres east to west.

The three main groups of islands are the North Isles, Mainland, and the South Isles. Mainland is the largest island. Hoy, in the South Isles, is next largest. There are

Stromness is an important ferry port for the Orkney Islands. It lies in the eastern part of Mainland, the largest of the islands.

many *skerries* (outcrops of rock that are submerged at high tide). The land is low lying. In many places it is overlaid by peat covered by grass or heather. Few trees grow on the islands because of the strong winds. Scapa Flow, to the south of Mainland, is an anchorage for large ships.

Climate. The sea has a great effect on the climate of Orkney. There are no extremes of temperature. The climate is mild in winter and cool in summer. The annual rainfall is 940 millimetres.

History. *Neolithic* (New Stone Age) people inhabited the Orkneys perhaps as early as 4,000 years ago. They built Maes Howe and Skara Brae. Remains of circular stone-walled structures called *brochs,* which date from between 100 B.C. and A.D. 200, exist on the islands. They may have been places of refuge.

The Vikings colonized the Orkneys during the 700's and 800's and ruled until 1468. Christian I of Denmark and Norway pledged the islands to Scotland to make up his daughter's dowry for her marriage to Scotland's James III. Many place names and family names in the islands are Norse in origin. The islands have their own saga, which is called the *Orkneyinga Saga.* It records the story of the earls of Orkney in the medieval period (see **Saga**).

During the 1800's, Stromness became an important port for the trading ships of the Hudson's Bay Company, for whalers and sealers, and for herring boats. During World Wars I and II, Scapa Flow was an important naval base. Since the 1970's, the search for and exploitation of oil from the North Sea has brought many jobs to Orkney.

Related articles in ***World Book*** include:

Pentland Firth	Scapa Flow	Shetland

Orlando, Florida (pop. 164,693), is a popular winter resort and tourist centre in the United States. Orlando's warm climate has helped to make it one of the fastest-growing cities in the United States. Walt Disney World opened about 24 kilometres southwest of the city in 1971. This famous entertainment centre has contributed greatly to Orlando's rapid growth. Many people, including large numbers of retired citizens, have settled in Orlando because of the mild climate. Orlando also is the commercial centre of a large fruit-growing area.

The development of Walt Disney World led to many construction projects in Orlando. They included apartment buildings, banks, hotels, motels, restaurants, and shopping areas. In 1972, Orlando completed a new Municipal Justice Building. A Civic Theater opened in 1973. In 1982, Walt Disney Productions opened EPCOT Center, a permanent world's fair, at Walt Disney World. Another attraction there is the Disney-MGM Studios Theme Park, which opened in 1989.

Orlando, Vittorio Emanuele (1860-1952), served as prime minister of Italy from 1917 to 1919. He took office just after the Italian Army suffered a terrible defeat in World War I. He helped raise civilian morale and spur the army on to victory.

Orlando began his political career in the Italian Chamber of Deputies in 1897. Between 1903 and 1917, he held various government jobs. He led the Italian delegation to the Versailles Peace Conference in 1919. He made strong demands there for increased territory for Italy. When the Allies failed to give Italy all that Orlando wanted, he was forced to resign as prime minister.

In 1922, Orlando supported Benito Mussolini, who became prime minister of Italy that year and soon began to create a dictatorship. But he denounced him in 1925, after Mussolini's henchmen murdered a Socialist leader. Orlando helped overthrow Mussolini in 1943. Orlando was born in Palermo, Sicily.

Orléans was the name of two branches of the royal French family, the houses of Valois-Orléans and Bourbon-Orléans (see **Bourbon; Valois**).

Louis (1372-1407) founded the house of Valois-Orléans. He was the second son of King Charles V, and the brother of Charles VI. Louis became duke of Orléans in 1392. He wanted to rule when Charles VI became mentally ill, but his uncle, Philip of Burgundy, ruled. After Philip's death, his son John plotted Louis' assassination.

Philippe (1640-1701), the son of Louis XIII and the only brother of Louis XIV, founded the house of Bourbon-Orléans. He became duke of Orléans in 1661.

Philippe (1674-1723), son of the founder of the Bourbon-Orléans branch, became duke of Orléans in 1701. He acted as regent of France until Louis XV came of age. He let John Law introduce a large amount of paper currency, which led to bankruptcy.

Louis Philippe Joseph (1747-1793), the grandson of Philippe, was known as Philippe Egalité (Equality). He took this name during the French Revolution to show the people that he sided with them against the nobles. He voted for the death of King Louis XVI. But Philippe and other members of the Bourbon family were arrested in 1793, and he was beheaded. He was the father of Louis Philippe. Ferdinand, the eldest son of King Louis Philippe, became the duke of Orléans when his father became king.

Louis Philippe Robert (1869-1926), the grandson of Ferdinand, was the last real claimant to the throne of France. He was a famous scientist, and led expeditions to the Arctic regions and to British East Africa. He was born in Twickenham, England, and was exiled from France in 1886.

Orléans (pop. 107,965; met. area pop. 243,153) is an important commercial centre in north-central France. It lies along the Loire River. For location, see **France** (political map).

Orléans is located in the Loire Valley, a region famous for its many estates and *chateaux* (large country houses). The city has a number of medieval buildings—including the Gothic Cathedral of St. Croix and the University of Orléans. Important in flower production, Orléans grows most of the commercially raised roses in France. Its many other products include cars, clothing, sweets, electric appliances, farm machinery, liqueurs, and pharmaceuticals. It is the capital of the Loiret *department* (administrative district) and the Centre region.

Roman soldiers established a colony at the site of what is now Orléans in 52 B.C. In 1429, Joan of Arc led the French Army in saving the city from English invasion.

Orléans, Battle of. See **Army** (table: Famous land battles).

Ormandy, Eugene (1899-1985), became one of the world's best-known conductors during his long career in the United States as director of the Philadelphia Orchestra. From 1936 to 1938, Ormandy shared the direction of the orchestra with Leopold Stokowski. Ormandy served as the orchestra's sole music director from 1938 to 1980. His performances stressed romantic and neoromantic music and emphasized fine string playing and rich orchestral tones. Under Ormandy's leadership, the orchestra toured many countries and made many recordings.

Eugene Ormandy Blau was born in Budapest, Hungary. He studied the violin with Jenö Hubay, a noted Hungarian violinist. In 1921, Ormandy went to the United States to make a concert tour. Instead, he became a violinist in the orchestra of the Capitol Theater in New York City. Soon he had opportunities to conduct and in 1931 he became principal conductor of the Minneapolis Symphony Orchestra. He held this position until moving to Philadelphia. Ormandy became a U.S. citizen in 1927.

Ornament. See **Art and the arts; Clothing; Gem; Jewellery** and their lists of *Related articles.*

Ornithischian. See **Dinosaur** (Kinds of dinosaurs).

Ornithology is the scientific study of birds. It includes the description, history, and classification of birds, their distribution, their activities, their ecological importance, and their economic value to people. The activities of birds that ornithologists study include mating, nesting, rearing of young, feeding, flight, navigation, and migration. Photography is used to document the activities of birds, and recordings are made of their songs.

The beauty of birds, their interesting habits, and their importance to people as a source of food, clothing, and other products attract professional and amateur scientists, as well as bird watchers. Many people belong to bird clubs. The International Council for Bird Preservation was founded in England in 1922.

See also **Bird** (Bird study and protection); **Audubon, John James; International Council for Bird Preservation; Radar** (In scientific research).

Ornithopod. See **Dinosaur** (Kinds of dinosaurs).

Ornithopter is a machine designed to fly by flapping its wings like a bird. No one has ever built a successful ornithopter, but people have dreamed of such a vehicle since ancient times. Some small-scale models have flown. But all attempts to build ornithopters that carry people have failed.

Ornithopters are classified in two ways. The first type uses various forms of wings for support in the air, and fastens the wings to a person's body. The second type uses a cabin or cockpit to house the pilot. The wings are attached and operated from the cockpit. The English philosopher Roger Bacon suggested the idea of the ornithopter about 1250.

See also **Aeroplane** (Early experiments and ideas); **Leonardo da Vinci** (picture).

Ornithosis. See **Psittacosis.**

Orozco, José Clemente (1883-1949), was a Mexican painter. He became known for murals that use themes from Mexico's history. Orozco's style emphasizes human figures portrayed with strong lines, dramatic angles, and brownish colours.

Orozco was born in Zapotlán. He spent his early career drawing political and satirical cartoons. In the early

An Orozco mural shows the god Quetzalcóatl rising above Aztec temples to arouse Amerindians to improve their culture.

1920's, Orozco and several other Mexican artists began painting frescoes on walls in public buildings (see **Fresco**). Unlike the work of fellow muralists Diego Rivera and David Siqueiros, Orozco's frescoes seldom contain political messages. Instead, his paintings express his reaction to the suffering and struggles of common people everywhere.

In the 1930's, Orozco turned to a more abstract style. Examples include the murals in public buildings in Guadalajara and Mexico City.

See also **Mexico** (picture: The Palace of Justice); **Painting** (picture: Fresco painting).

Orpen, Sir William (1878-1931), was an Irish painter. Some of his best-known paintings were done at the front in World War I (1914-1918). He was official painter at the Paris peace conference after the war. Orpen was born at Stillorgan, near Dublin. He studied at the Metropolitan School of Art in Dublin and at the Slade School of Fine Art in London. He later became a fashionable portrait painter.

Orphanage. See **Children's home; Foster parent.**

Orpheus was a musician in Greek and Roman mythology. The music of his voice and lyre was so beautiful that animals, trees, and stones followed him, and rivers stopped flowing to listen. His mother was the muse Calliope and his father was either the mortal Oeagrus or the god Apollo.

Orpheus joined the Argonauts in their quest to capture the Golden Fleece. Later, he married Eurydice, whom he loved dearly. After she died, he went to the Underworld to bring her back. His music charmed Hades and Persephone, the rulers of the Underworld, and they granted Eurydice permission to leave. But they warned Orpheus not to look back at her on the way up to the earth. He glanced back too soon and she disappeared.

Orpheus angered some women of Thrace because he took no interest in them or in their worship of the god Dionysus, and they tore him to pieces.

See also **Eurydice; Argonauts.**

Orr, Bobby (1948-), became famous as one of the greatest defencemen in the history of the U.S's National Hockey League (NHL). He was especially known for his skilful skating, high scoring, and team leadership.

Orr broke all major NHL scoring records for defencemen. He was the first defenceman to score more than 100 points in a season and the only one to lead the league in scoring. He won the scoring trophy twice. Orr also set the career record for most points scored by a defenceman. He was named the NHL's top defenceman eight times and was chosen the league's Most Valuable Player three times.

Robert Gordon Orr was born in Parry Sound, Ontario, Canada. He played in the United States for the Boston Bruins from 1966 to 1976, when he signed with the Chicago Black Hawks. He retired as a player in 1978.

Bobby Orr

Orrisroot is the dried, sweet-smelling *rhizome* (underground stem) of certain irises. It is used to give perfumes a scent of violets. The fragrant oil extracted from orrisroot is not so widely used as it once was, because of its high price and the availability of synthetic substitutes. But small amounts are still used in certain expensive perfumes. Orrisroot comes from three species—*Iris florentina, Iris germanica,* and *Iris pallida.* These irises are cultivated near Verona and Florence, Italy; and Grasse, France. The rhizomes are dug in the summer, and dried in the sun. They yield a waxy material containing an oil that smells like violets and is used in perfumes. See also **Iris.**

Ortega, Daniel (1945-), was head of Nicaragua's government from 1979 until 1990. In 1979, he was named the leader of a revolutionary government when his party, the Sandinista National Liberation Front, overthrew the government of Anastasio Somoza Debayle. Ortega was elected president of Nicaragua in 1984. His term as president ended in 1990, when he was defeated in a presidential election by Violeta Barrios de Chamorro, the leader of a coalition that opposed Sandinista rule.

Under Ortega, Nicaragua's government improved health care in rural areas, built many new schools, and reduced illiteracy. It also took control of many businesses, increased press censorship, and restricted the civil rights of its political opponents. Critics of Ortega, including the United States government, charged that he had set up a Communist dictatorship. In 1981, Nicaraguans who opposed Ortega's government—called *contras*—began a guerrilla war against the government. In 1988, Ortega helped negotiate a cease-fire between his government and the contras.

Daniel Ortega

Ortega's leadership of Nicaragua was greatly influenced by the country's relationship with the United States. The United States had been Nicaragua's chief trading partner until the Sandinista party came to power. The United States opposed Ortega's leadership. It sharply reduced trade with Nicaragua and provided funds to the contras. Ortega struggled to improve an economy crippled by the U.S. trade cuts, by the war against the contras, and by high government spending for health and education.

Ortega was born in the town of La Libertad. His full name is Daniel José Ortega Saavedra. In the 1960's, Ortega became a guerrilla leader of the Sandinista opposition to the Somoza government. He was imprisoned by the government from 1967 to 1974. After his release, he was exiled to Cuba where he recieved military training. He returned to Nicaragua and helped lead the overthrow of the Somoza government.

See also **Nicaragua** (Recent developments).

Ortega y Gasset, José (1883-1955), was a Spanish philosopher and essayist. He wrote *Meditations on Quixote* (1914), which anticipated themes that existentialist philosophers made popular more than 10 years later. Ortega emphasized the idea that we are "condemned to be free," and therefore all individuals must determine their own place in history. See **Existentialism.**

Ortega cherished aristocratic values. He felt that without spiritual leadership from the top, society would be drawn down to the level of its lowest members. For Ortega, this problem was especially serious because of the decline of self-confidence he saw in Europe, and the rise of merely technical modes of thought and organization in the 1900's. He explored these ideas in his best-known book, *The Revolt of the Masses* (1930). In *The Dehumanization of Art* (1925), Ortega discussed the tendency of modern art to rid itself of human content.

Ortega was born in Madrid. He was strongly influenced by the philosophy of Immanuel Kant while he was studying in Germany. Ortega was professor of philosophy at Madrid University from 1910 to 1936. Because of the Spanish Civil War, he lived in exile from 1936 to 1945, when he returned to Spain.

Orthodontics is the branch of dentistry that prevents and corrects irregular positions of the teeth. In addition to causing poor personal appearance, irregularly positioned teeth are difficult to clean. Thus, they are more likely to decay and promote gum diseases (see **Teeth** [Periodontal diseases]). They also can cause chewing and speech problems.

Irregularities in the position of teeth are called *malocclusions.* Malocclusions usually arise during childhood as the teeth grow. They most commonly occur when the teeth are too large for the available jaw space. Under such conditions, the teeth become crowded and turned out of position. In some cases, one of the jaw bones is larger than the other, creating a condition of overbite or underbite.

Malocclusions can sometimes be prevented by the early removal of certain *deciduous teeth* (baby teeth). This process, called *serial extraction* or *guidance eruption,* relieves crowding that occurs as new teeth break through the gums. If the teeth are already out of position, orthodontists cement metal or plastic braces around each tooth and connect the braces with wires. By gradually tightening the wires, they move the teeth into proper position. In some cases, a tooth is extracted so that other teeth can be moved into its place.

Orthodontic treatment is typically begun when patients are 10 to 16 years old and lasts about two years. Many adults also undergo orthodontic treatment, but treatment time is generally longer.

See also **Dentistry; Teeth** (Malocclusion).

Orthodox, Eastern. See **Eastern Orthodox Churches.**

Orthopaedics is a branch of medicine that deals with disorders of the bones and muscles and their associated tissues. Doctors who practise orthopaedics are called *orthopaedic surgeons.* They treat a broad range of medical problems, including fractures, injuries to tendons and ligaments, and deformities of the limbs and spine.

Some orthopaedic disorders are present at birth. Others occur during childhood due to problems of growth or in later life as a result of aging. Still others result from injury or illness. People injured in car accidents and athletic or recreational activities account for a large number of the patients treated by orthopaedic specialists.

In treating orthopaedic disorders, doctors prescribe drugs, surgery, or physiotherapy. For example, the specialist may perform surgery to correct a fracture or deformity. After the surgery, the specialist may apply a cast or brace and prescribe physiotherapy to aid healing. Such therapy might involve use of a device that produces electrical impulses that promote bone healing. The specialist also may perform surgery to replace an injured or arthritic joint with an artificial joint made of plastic, metal, or other materials. The joint most commonly replaced is the hip.

Orthoptera. See **Insect** (table).

Orwell, George, was the pen name of Eric Arthur Blair (1903-1950), an English novelist and social critic. Orwell became famous with his novel *1984,* published in 1949. The book is a frightening portrait of a totalitarian society that punishes love, destroys privacy, and distorts truth. The grim tone of *1984* distinguishes it from Orwell's *Animal Farm* (1945), an animal fable satirizing the communist government of the Soviet Union under Stalin.

Orwell was a unique combination of middle-class intellectual and working-class reformer. A strong autobiographical element runs through most of Orwell's writing, giving both his novels and essays a sense of immediacy and conviction. For example, his experiences living in poverty colour *A Clergyman's Daughter* (1935). The novel attacks social injustice and ranges from the miseries and hypocrisies of the poor of middle-class background to the near-starvation of the slumdweller. *Homage to Catalonia* (1938) is a nonfiction work based on Orwell's brief career as a soldier. He describes his disillusionment with the Loyalists during the Spanish Civil War.

George Orwell

Orwell was born in Bengal, India, the son of an English civil servant. He attended Eton public school in England from 1917 to 1921 and served with the Indian Imperial Police in Burma for five years. On his return to England in 1927, he chose to experience a life of poverty, and lived as a tramp in England and Europe until the mid-1930's. *Down and Out in Paris and London* (1933) is an account, in fictional form, of his experiences during this period.

Oryx is the name of three species of antelope that live in desert regions. They all have light-coloured coats that blend in with their backgrounds. They also have distinct dark patches on the face. Oryx measure up to 1 metre at the shoulders.

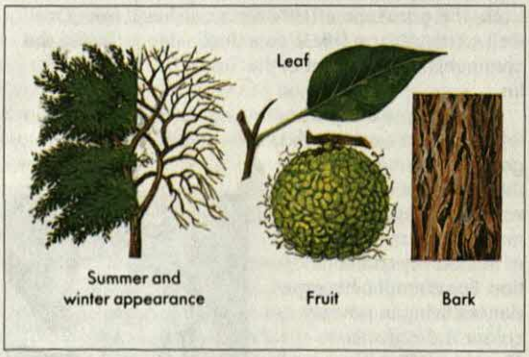
The oryx of eastern and southern Africa is also known as the *gemsbok* or *beisa* (see **Gemsbok**). The gemsbok and Arabian oryx have long, straight, pointed horns. The scimitar-horned oryx of northern Africa has large backward-sweeping horns.

The Arabian oryx has been brought back from the verge of extinction by extensive *captive breeding* (breeding in captivity) programmes in several countries of the Arabian Gulf. One of the first successful attempts at captive breeding was from a herd reared at Phoenix Zoo in Arizona in the southwestern United States. The scimitar-horned oryx has also been bred in captivity, and released in the wild.

Oryx have become rare mainly due to hunting.

Scientific classification. Oryx belong to the family Bovidae, genus *Oryx.* The gemsbok is *O. gazella,* the Arabian oryx is *O. leucoryx,* and the scimitar oryx is *O. dammah.*

Osage orange is a small- to medium-sized tree planted across the United States for hedges, ornamental purposes, and shade. It originally was found in Texas, Oklahoma, and Arkansas. The name refers to the Osage Indians of that region, and to the tree's greenish-yellow fruit, which looks like an orange but is inedible. The Osage orange is sometimes called *bodark, bois d'arc, bowwood,* or *hedge apple.*



The Osage orange has greenish-yellow fruit that resembles an orange. The tree has a short trunk and crooked branches and long, pointed leaves. Its yellow wood is hard and durable.

The tree has a short trunk and crooked branches. Its long, pointed leaves are a shiny dark green. It has thorny twigs and a milky, bitter sap. Pioneers planted Osage orange trees as a "living fence" around their farms before barbed wire came into use.

The yellow wood of the Osage orange is hard, strong, and durable. The Indians preferred it for their bows and war clubs. It makes good fence posts and was used for wagon wheels. A yellow dye can be made by boiling chips of the wood in water.

Scientific classification. The Osage orange tree belongs to the mulberry family, Moraceae. It is *Maclura, pomifera.*

Osaka (pop. 2,636,260) is the third largest city in Japan. Only Tokyo and Yokohama have more people. Osaka, an important industrial and commercial centre, lies on Osaka Bay on the southern coast of Honshu Island (see **Japan** [political map]).

Osaka covers about 205 square kilometres. It is sometimes called the "Venice of Japan" because of its many canals and rivers. Since the 1960's, some of these waterways have been filled and highways built over them.

Central Osaka lies on the delta of the Yodo River. Office buildings, shops, hotels, restaurants, and entertainment centres fill this section of the city. Many shopping centres have been built underground because of a shortage of land.

Osaka has many museums, theatres, and religious shrines. Osaka Castle, built in 1584, houses a museum with historical exhibits. Bunraku Theatre presents puppet shows, and Kabuki Theatre offers stage performances. Osaka has 13 universities, including government-supported Osaka University. In 1970, Osaka was the site of Expo '70, the first world's fair to be held in Asia.

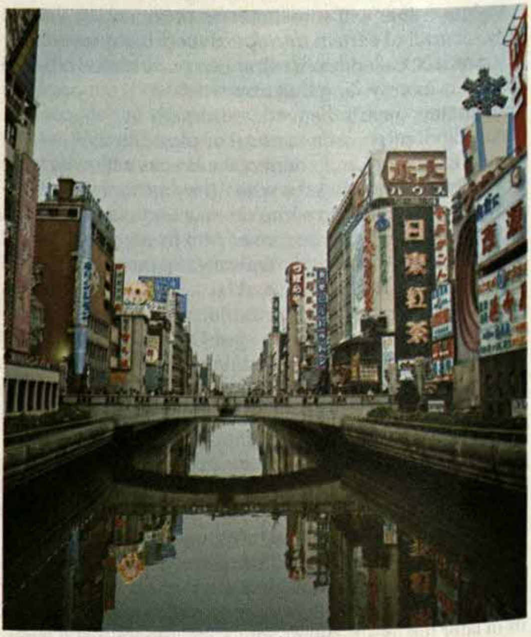
In the past, most Osakans lived in small wooden houses. Today, many Osaka residents live in large blocks of flats. The city's population increased by more than a million during the 1950's, and this rapid growth led to shortages of land and housing. Many Osakans have moved to the suburbs to escape the city's crowded conditions, high prices, and pollution.

Osaka is famous for its good food, especially seafood. Local specialties include eel; shrimp; turtle; and *kaminabe,* a fish stew cooked in a paper pot.

Osaka produces about 25 per cent of all the products manufactured in Japan, including 40 per cent of Japan's exports. Osaka exports clothing, electrical appliances, and fabrics. It imports raw materials, especially cotton. The city is also a financial and trade centre.

Osaka has serious traffic problems in spite of efforts to improve public transportation. Buses, an underground railway system, and commuter trains serve the city. Some of the world's fastest trains travel between Osaka and Tokyo, a distance of about 400 kilometres. These trains reach speeds of about 200 kilometres per hour. Osaka International Airport is one of the busiest in Asia.

Osaka was settled in ancient times. It later became Japan's major port and commercial centre. Toyotomi Hideyoshi, the ruler of Japan from 1585 to 1598, encouraged merchants to move to Osaka. The government opened Osaka's port to foreign trade in 1868.



Osaka, Japan's third largest city, is an important commercial and cultural centre. Numerous canals and rivers run through the city, which lies on the southern coast of Honshu Island.

Allied bombing raids destroyed much of Osaka during World War II (1939-1945). The people rebuilt their city after the war. Osaka's population growth created a need for more housing, sewers, roads, and railways. Many of these improvements were completed during the city's preparations for Expo '70.

Osborne, John (1929-), an English dramatist, became famous with his first important play, *Look Back in Anger* (1956). The drama deals with Jimmy Porter, an educated but poor young man. Porter lashes out at everyone around him in anger and frustration because the world no longer offers any ideals or causes he can believe in. *Look Back in Anger* was a vivid contrast to the sort of polite upper-middle-class stories and characters presented in most British plays of the time. It was the first of a new kind of play of protest that came to be known as *kitchen sink* drama.

Osborne's other early plays also criticized society. *The Entertainer* (1957) uses a run-down old comedian to symbolize the decline of the British Empire. *Luther* (1961) presents a modern interpretation of Reformation religious leader Martin Luther as a troubled rebel. *Inadmissible Evidence* (1964) portrays the breakdown of a successful lawyer as he realizes how empty his life is. As Osborne grew older, his plays became more conservative. He defended the way of life he had once criticized and attacked younger social critics. He also wrote an autobiography, *A Better Class of Person* (1981). John James Osborne was born in London.

Oscan was a language used by one of the earliest known peoples of Italy. It was part of the Indo-European family, and was distantly related to Latin.

Oscar. See **Film Industry** (Festivals and awards).

Oscillation. See **Electronics** (Oscillation).

Oscillograph. See **Oscilloscope.**

Oscilloscope is an electronic instrument that displays changing electrical signals. The signals appear as straight or wavy lines or in other patterns on a fluorescent screen.

Oscilloscopes are used in such fields as industry, medicine, and scientific research. Electronics engineers use the instruments to test computers, radios, and other electronic equipment. Doctors use them to study electrical impulses from the brain or heart. Light, mechanical motion, and sound can be studied with oscilloscopes. Devices called *transducers* change these forms of energy into electrical signals.

The screen of an oscilloscope is the front of a *cathode-ray tube,* a special type of vacuum tube. Inside the tube, a device called an *electron gun* projects a beam of electrons onto the fluorescent screen. Any movement of this beam leaves a glowing line on the screen. A circuit called the *time base* causes the beam to move repeatedly from left to right. At the same time, the signal to be studied is fed into the oscilloscope and causes the beam to move up and down. This movement corresponds to *oscillations* (vibrations) in the signal. The beam moves up and down while moving from left to right, and so traces a pattern on the screen. This pattern represents the oscillating signal.

An oscilloscope is a type of *oscillograph,* which is any instrument that displays or records electrical signals. Certain types of oscillographs change electrical signals into mechanical movements that are recorded on paper or photographic film. For example, some oscillographs use a lightweight pen called a *stylus* to draw a wavy line on a moving paper chart.

An oscilloscope shows electrical or sound waves or other vibrations as patterns on a fluorescent screen.

See also **Cathode rays.**

O'Shane, Pat (1941-), an Australian lawyer, became Australia's first Aboriginal barrister in 1976. Patricia June O'Shane was born in Mossman, Queensland. She was educated at Cairns High School and at Kelvin Grove Teachers' College in Brisbane. From 1962 to 1972, she taught at Cairns High School. In 1973, she moved to Sydney, where she studied law at the University of New South Wales. After graduation, she practised law with the Aboriginal legal services in Sydney. From 1978 to 1981, she was the coordinator of a task force assisting a New South Wales parliamentary inquiry on Aborigines. She worked as secretary of the ministry of Aboriginal affairs in New South Wales from 1981 to 1986, at which time she became a magistrate.

Osier is the name of certain shrubs and small trees in the willow family. They grow best along streams. These willows have tough, slender stems that can be used for making baskets and furniture. The *common osier* and the *purple osier* are cultivated for their flexible stems. An American dogwood is called *red-osier dogwood* because its bark resembles that of some willows.

Scientific classification. Osiers belong to the willow family, Salicaceae. The common osier is *Salix viminalis.* The purple osier is *S. purpurea.* The red-osier dogwood is in the dogwood family, Cornaceae. It is *Cornus stolonifera.*

See also **Willow.**

Osiris was an Egyptian fertility god who became the chief god of the underworld. He is generally shown as a bearded human mummy with green or black flesh. He holds a shepherd's crook and a whip and wears a conical white crown with ostrich feathers on either side.

As son of the earth god Geb, Osiris was regarded as a source of the earth's fertility. Egyptians sometimes compared him to the Nile River. As a popular Egyptian deity, Osiris was often identified with other deities. At Busiris in the delta region, he absorbed the characteristics of an earlier god-king. At the burial ground at Abydos, he replaced a god of the dead.

In Egyptian royal theology, the king was a living Horus, who was the son of Osiris. After the king died, he became Osiris. After Egyptian funeral practices became

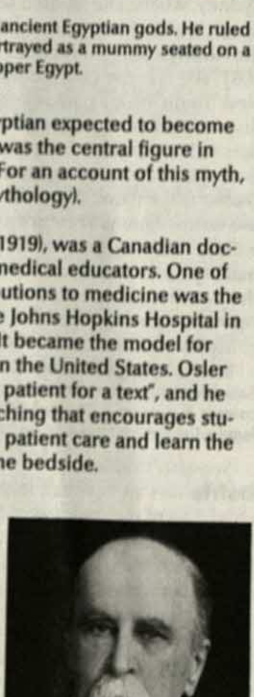
Osiris was one of the principal ancient Egyptian gods. He ruled the underworld and is often portrayed as a mummy seated on a throne wearing the crown of Upper Egypt.

more democratic, every Egyptian expected to become an Osiris after death. Osiris was the central figure in Egypt's most popular myth. For an account of this myth, see **Mythology** (Egyptian mythology).

See also **Isis; Set.**

Osler, Sir William (1849-1919), was a Canadian doctor and one of the greatest medical educators. One of Osler's most notable contributions to medicine was the organization of a clinic at the Johns Hopkins Hospital in Baltimore, Maryland, U.S.A. It became the model for modern medical education in the United States. Osler strongly favoured using "the patient for a text", and he perfected the method of teaching that encourages students to become involved in patient care and learn the practical art of medicine at the bedside.

Osler discovered the presence in the bloodstream of what later were called *discs,* or *blood platelets* (see **Blood** [Platelets]). Among his many scientific papers are important studies of the heart and research on typhoid fever, pneumonia, malaria, infant mortality, and other medical and public health problems.



Sir William Osler

His writings. Osler published *Principles and Practice of Medicine* in the United States in 1892. In 1897, an adviser to John D. Rockefeller, wealthy American philanthropist, read the book and was inspired by the potential of medical research, especially in microbiology. This incident led to the founding of the Rockefeller Institute for Medical Research in 1901. Osler's humanistic essays were collected in *Aequanimitas* (1904) and *An Alabama Student* (1908).

His life. Osler was born on July 12, 1849, in Bondhead, Ontario, Canada. He graduated from McGill University, Montreal, in 1872. He served at McGill from 1875 to 1884 as a lecturer in physiology and as professor of medicine. In 1884, he became clinical professor of medicine at the U.S. University of Pennsylvania. He was appointed professor of medicine at the new Johns Hopkins University in the U.S. four years later. At the same time, he was made physician-in-chief to the new hospital there. Osler went to Oxford University, in England, in 1905 as Regius professor of Medicine, one of the most prestigious medical positions in Great Britain. He became a baronet in 1911. He helped organize the British medical profession during World War I (1914-1918).

Oslo (pop. 449,220) is the capital and largest city of Norway. It is also the nation's chief economic, industrial, and cultural centre, and one of its leading seaports. Oslo lies on the southeast coast at the head of the great Oslo Fiord. The city is about 130 kilometres north of the Skagerrak, an arm of the North Sea (see **Norway** [map]). From 1624 until 1925, Oslo was called Christiania in honour of King Christian IV, who planned the rebuilding of the city after a fire destroyed it.

The Royal Palace and the Parliament Building stand along Karl Johans Gate, the main street in the central section of Oslo. City Hall, the medieval Akershus Castle, and the city's commercial district are south of Karl Johans Gate.

Oslo has Norway's oldest and largest university, an Evangelical Lutheran cathedral, and many museums. The Viking Ships Museum displays ships used by the Vikings about a thousand years ago. The Fram and Kon-Tiki museums house the *Fram,* a famous polar exploration ship; and the *Kon-Tiki,* the raft of anthropologist and adventurer Thor Heyerdahl (see **Heyerdahl, Thor**). Other museums include the Norwegian Folk Museum, Norwegian Maritime Museum, Historical Museum, and Edvard Munch Museum. About 150 works by Gustav Vigeland, one of Norway's greatest sculptors, are in Oslo's Frogner Park.

Manufacturing employs about 25 per cent of Oslo's workers. Major industries include shipbuilding and the production of chemicals, machinery, metals, paper, textiles, and wood products. Banking, communications, electronics, food processing, shipping, and tourism also play important roles in the city's economy. Oslo is the hub of the Norwegian national railway system. An international airport lies just outside the city.

Oslo was founded by King Harold Hårdråde about 1050. In 1299, Akershus Castle was built on a rocky peninsula overlooking the fiord. Fire destroyed Oslo in 1624, but the people rebuilt the city northeast of the castle. Norway was united with Denmark from 1380 to 1814, and with Sweden from 1814 to 1905. In 1905, it became independent, with Oslo as the capital. By the mid-1800's, the city had grown into a major administrative, economic, and military centre. The development of shipping and industry, plus the forest and agricultural resources of southeastern Norway, helped give Oslo the dominant role in the nation's economy that it still has.

See also Norway (Climate; pictures).

Osmeña, Sergio (1878-1961), a Filipino statesman, was president of the Philippines from 1944 to 1946. In 1907, he founded the *Partido Nacionalista* (National Party), which became the country's most influential political party. He led the party until 1921.

Osmeña was born in Cebu City, on the central Philippine island of Cebu. In 1903, he graduated in law from the University of Santo Tomas, in Manila. He became a well-known nationalist leader editing *El Nuevo Dia (The New Day),* a Spanish language newspaper in Cebu City. He served as governor of Cebu from 1904 to 1907. In 1907, Osmeña was elected as a representative in the first Philippine National Assembly. In 1935, Osmeña became vice president of the Commonwealth of the Philippines. When the Japanese invaded the Philippines in 1942, Osmeña went to the United States. On President Manuel Quezon's death in 1944, Osmeña became president and returned to the Philippines. In the 1946 presidential elections, Osmeña was defeated by Manuel Roxas.

Osmium is a hard metallic element, symbol Os. It is twice as heavy as lead, and has a density of 22.48 grams per cubic centimetre at 20° C. It has an atomic weight of 190.2 and its atomic number is 76. Its chemical symbol is Os. Smithson Tennant, a British chemist, discovered osmium in 1804. Osmium is refined from the same ores in which platinum is found. Some osmium has been found in platinum mines in California and Tasmania.

The pure metal is a fine, black powder or a hard blue-grey mass. The boiling point of osmium is about 5300° C. Its melting point is 2700° C, but it can vaporize before a high temperature is reached. When heated above 93° C, osmium gives off a vapour that can damage the eyes, lungs, and skin. The metal is used to tip pen points and record player styluses, and to make standard weights and measures.

Osmosis is the movement of liquid from one solution into another through a membrane that separates them. The process is essential for the survival of living things. For example, a plant absorbs most of its water by means of osmosis. In animals, osmosis helps regulate the flow of water between body fluids and cells. Osmosis also has several industrial uses, such as water purification and food preservation.

How osmosis works. A mixture of substances that cannot be separated mechanically is called a *solution.* A liquid solution consists of a dissolved substance called a *solute* and a liquid called a *solvent.* During osmosis, some of the solvent from one solution moves through a membrane into another solution. The membrane is *semipermeable*—that is, it allows some substances, but not others, to pass through. The solvent moves between the solutions according to the number of the molecules of the solute and the temperature and pressure of each solution. In normal osmosis, the solvent moves into the solution that contains more solute molecules.

Osmosis can be demonstrated by performing the following experiment. First, fasten a piece of cellophane tightly over the bottom of a glass tube and put some sugar solution into the tube. Then, place the tube in a container of pure water so that the levels of the water and the sugar solution are equal. After several hours, the liquid inside the tube rises because water has moved into the sugar solution.

Oslo is the capital and largest city of Norway. It also ranks as the country's leading seaport. Passenger ships, cargo vessels, and fishing boats dock at Oslo's busy harbour, *above right.* Many parks and gardens, such as the one shown above on the left, add to the scenic beauty of the city.

Water moves into the sugar solution because water molecules are smaller than sugar molecules. Thus, only water molecules pass through the cellophane, which is the semipermeable membrane. At the same time, the larger sugar molecules interfere with the water molecules in the tube and prevent some of them from moving through the membrane. As a result, more water moves into the tube than out of it.

As the water moves into the tube, the sugar solution rises and causes the pressure in the tube to increase. The solution continues to rise until the pressure in the tube equals the pressure of the water entering it. The pressure of the water is called *osmotic pressure.*

Osmosis and life. In the human body, osmosis plays an important part in the function of the kidneys. It also results in the transfer of water and various nutrients between the blood and the fluid of the cells.

Plant roots take in water and some minerals as a result of the osmotic process. Osmosis helps to transport the water and to maintain a plant's shape and stiffness.

Uses of osmosis. Chemists use a process called *reverse osmosis* to purify water. In normal osmosis, water flows from fresh water into seawater when the seawater and the fresh water are separated by a semipermeable membrane. But if pressure is applied to the seawater, the movement of water reverses direction, and fresh water is produced from seawater. Some shipwreck victims have used survival kits that filter drinking water out of seawater by osmosis.

Osprey, also called *fish hawk,* is a fish-eating bird. Ospreys feed by making spectacular plunges into water from heights of 15 to 30 metres. They hit the water feet first with a great splash and seize a fish with their long, slender claws. These birds live throughout the world along rivers, lakes, seacoasts, and bays. Ospreys in northern regions migrate to warm areas for the winter.

The osprey is about 60 centimetres long, with a wingspread of nearly 2 metres. It is dark brown above and has some white on its head. It is white below with a few streaks of dark brown.

The osprey is a brown-and-white bird of prey. It lives near bodies of water and feeds on fish swimming near the surface.

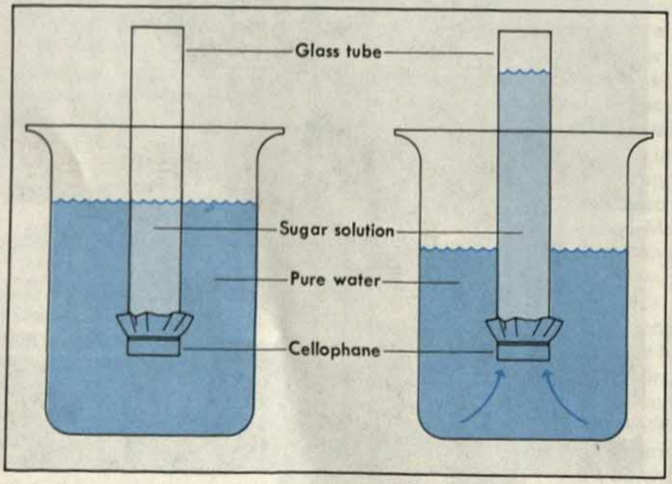
Ospreys nest in trees, jagged rocks, or low bushes, or on the ground. Ospreys build extremely large nests. Some nests measure up to 2 metres across. Nest-building materials include seaweed, sticks, bones, or driftwood. Ospreys usually lay three eggs. Incubation of the eggs lasts about 37 days.

Insecticides such as DDT and human disturbance of the bird's habitat have reduced the number of ospreys in several locations. In some places, ospreys are considered endangered birds.

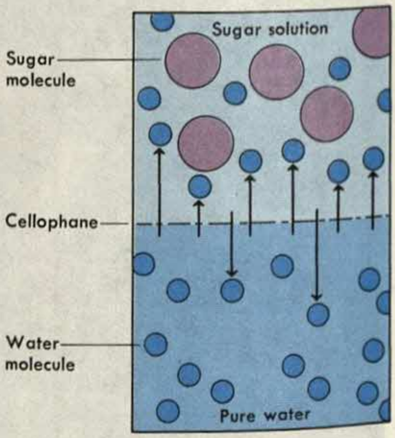
Scientific classification. The osprey belongs to the family Accipitridae. It is *Pandion haliaetus.*

Ossining Correctional Facility. See Sing Sing.

How osmosis works



The process of osmosis can be demonstrated in the experiment shown above. Water enters the glass tube through the cellophane, which serves as a semipermeable membrane. As the water mixes with the sugar solution, the solution rises.



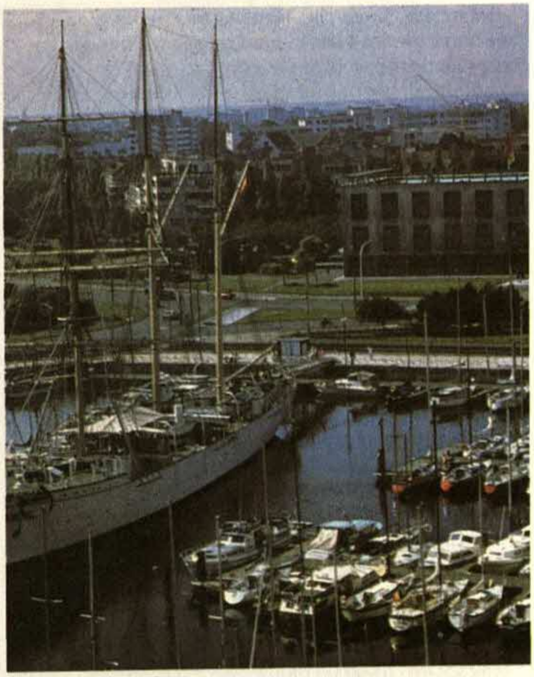
Molecules of water pass through the cellophane, as shown in the above diagram, but the larger sugar molecules do not. The level of the sugar solution rises because more water molecules move into the solution than out of it.

Ostend (pop. 69,129) is a Belgian city on the North Sea, about 125 kilometres northwest of Brussels (see **Belgium** [political map]). Ostend lies in the Dutch-speaking region of Belgium. Its name in Dutch is *Oostende*. It is an important Belgian port. Ostend conducts an export-import business with many countries. It is a harbour for cross-channel boats from Dover, England. Ostend fishermen catch cod and herring. Oysters are cultivated offshore. Ostend is a fashionable summer resort. Visitors enjoy its sea-front promenade and listen to concerts in a building called the *Kursaal*, the centre of the city's social life.

Dutch, Spanish, and French troops have fought many battles for Ostend, because of its value as a port. In 1865, its fortifications were destroyed by the Belgian government, and Ostend became important for shipping. Ostend was damaged in World War I (1914-1918) and again in World War II (1939-1945).

Osteology is the science concerned with the structure and function of bones. Osteologists study the bones of human beings and animals. They can determine the sizes and living habits of prehistoric animals from bones. They also can tell the age, sex, height, and weight of the person or animal from which the bones came. Osteology also includes the study of bone disorders and diseases. See also **Bone.**

Osteomyelitis is an inflammation of bone and *bone marrow*, the jellylike material in the core of bones. Osteomyelitis is caused by infection, usually from a bacterium called *Staphylococcus aureus*. Infection of bone marrow may occur if a person has a compound fracture. In such a fracture, bone marrow may be exposed to air containing bacteria. In other cases, the blood carries bacteria from a boil, from infected tonsils, or from infection somewhere else in the body to the bone marrow. Symptoms of acute osteomyelitis include fever, chills, pain over the infected bone, and nausea. Doctors usually treat the infection with antibiotics. Occasionally, surgical drainage may be necessary. Delay in treating osteomyelitis may result in bone shortening and consequent deformity.



The yacht harbour at Ostend, a Belgian port on the North Sea coast. Ostend is a popular holiday resort connected with England by cross-channel ferry services.

Osteopathic medicine is a system of medical care based on the belief that all body systems are interrelated. Disease in one part of the body affects other parts of the body and, therefore, the whole person must be considered in providing treatment. Osteopathic medicine emphasizes the importance of the body's *musculoskeletal system*. This system consists of the muscles and bones and their connecting tendons and ligaments.

An osteopathic doctor examines a child to detect disturbances in his musculoskeletal system. Osteopathic doctors treat their patients using osteopathic manipulation and massage in addition to other aspects of medicine.

Osteopathic medicine involves all aspects of medicine and includes various medical specialities. Osteopathic doctors use all the medical, surgical, immunological, pharmacological, psychological, and hygienic procedures of modern medicine.

The musculoskeletal system makes up 60 per cent of the body's weight. Because this system is so extensive, osteopathic medicine maintains that it has especially important interrelationships with other body systems. The musculoskeletal system may be affected by many internal illnesses and, in turn, may speed or worsen the process of disease in other body systems, including the circulatory system and the nervous system. Osteopathic doctors are trained to use osteopathic manipulation of the musculoskeletal system as a diagnostic and treatment tool, when it is appropriate. Such *osteopathic manipulative treatment* (OMT) is a distinctly osteopathic approach to the problems of health and disease.

History. The founder of osteopathic medicine was Andrew Taylor Still, an American medical practitioner. Still announced the basic principles of the osteopathic system in 1874. In 1892, he organized the first osteopathic college, which was established at Kirksville, Montana, U.S.A.

Osteopathy. See **Osteopathic medicine.**

Osteoporosis is a loss of bone tissue. Normal bones consist of a series of thin, intersecting plates surrounded by a dense shell. In osteoporosis, the plates become filled with holes—or may even disappear entirely. The shell often becomes thinner, as well. The bone is extremely fragile, and may fracture from even minor injuries. Although osteoporosis takes years to develop, there is usually no warning of its presence until such an injury occurs.

Osteoporosis can result from a number of diseases or conditions that reduce bone mass. These include various hormonal diseases, local injury or inflammation, and lack of physical activity, as well as the natural loss of bone that occurs as a person grows older.

The most common form of osteoporosis affects women who are past *menopause*—the time in a woman's life when menstruation stops. Such *postmenopausal osteoporosis* most often results in fractures of the wrist, spine, and hip bones. Scientists are not certain what causes postmenopausal osteoporosis, but they know that lack of *oestrogens* accelerates bone loss in women. Oestrogens are female sex hormones. Their production nearly ceases after menopause. Another important factor in postmenopausal osteoporosis may be insufficient intake of calcium. Calcium is vital to the development and maintenance of strong bones throughout life.

There is no cure for postmenopausal osteoporosis, but prompt treatment can slow further bone loss. Both oestrogen drugs and calcium supplements have proved effective in slowing bone loss. However, prolonged use of large amounts of oestrogen drugs may be harmful (see **Oestrogen**). To prevent osteoporosis, doctors recommend a lifelong combination of regular exercise and a diet containing adequate amounts of calcium.

Osteosclerosis means hardening, thickening, and increased density of bone. It may involve part of a bone, a whole bone, or the whole skeleton. The most common form, called *marble bones* or *osteopetrosis,* is a rare inherited disease that occurs in children. In this disease, the bones become excessively dense and thick. This increased thickness fills in the space containing the bone marrow, the tissue that makes red blood cells. As a result, the child develops severe anaemia.

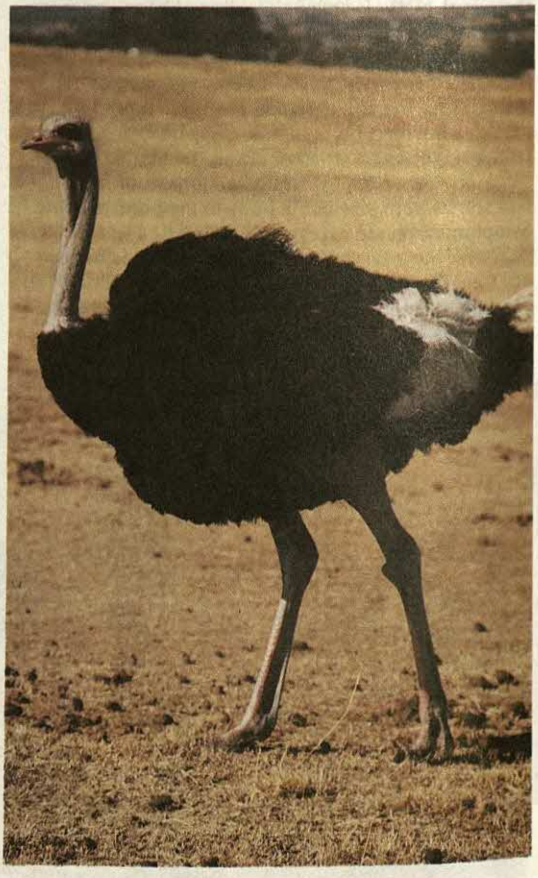
Bones affected by osteosclerosis become brittle and fracture more easily than do normal bones. Osteosclerosis may develop in part of a bone as a result of an infection or tumour.

Ostracoderm. See **Fish** (The first fish).

Ostrava (pop. 331,448) is one of the largest cities in the Czech Republic. It lies in the northeastern part of the country (see **Czech Republic** [map]).

Ostrava is the centre of the country's largest industrial area. The city is known for its great iron and steel works and for its manufacture of metal products. The region also has coal mines, petroleum refineries, and chemical plants. Other products of Ostrava include housebuilding materials, food products, clothing, and furniture.

Ostrich is the largest living bird. It may stand nearly 2.5 metres tall and weigh as much as 155 kilograms. Ostriches live on the plains and deserts of Africa. The extinct moas of New Zealand, which were 3 metres tall, were the only birds taller than ostriches. The extinct ele-



The ostrich is the world's largest bird. Adults stand nearly 2.5 metres tall and may weigh up to 155 kilograms. The male, *above,* has black and white feathers.

© Giuseppe Mazza

A female ostrich stands guard over a nest of eggs. Three to five females lay their eggs in the same nest.

phant birds of Madagascar, which weighed about 450 kilograms, were the only heavier birds. See **Elephant bird; Moa.**

The ostrich is the only bird that has only two toes on each foot. The rhea, also called the *South American ostrich,* is three-toed and is not a true ostrich. See **Rhea.**

The male ostrich has black feathers on its bulky body, with large white feathers, called *plumes,* on its wings and tail. The feathers on a female ostrich are dull brown. The ostrich's long, thin legs, upper neck, and small head have almost no feathers. The bare skin ranges in colour from pink to blue. Thick eyelashes surround its eyes, which are almost 5 centimetres in diameter.

The male ostrich gives a deep roar like that of a lion, but with a strange hissing sound. The ostrich cannot fly, but it is able to travel fast on the ground. Its long legs can take 4.5-metre steps at speeds up to 60 kilometres per hour.

The ostrich's speed and sharp eyesight help the bird escape from its enemies, mainly lions, cheetahs, and people. When the ostrich is exhausted and cannot run any farther, or if it must defend its nest, it kicks with its powerful legs. Its toes, the largest of which is 18 centimetres long, have thick nails that serve as weapons. The belief that the ostrich hides its head in the sand when frightened is not true, but stems from the bird's habit of rearranging the eggs in its nest with its bill. From a distance, the ostrich's head seems to disappear into the sand.

How the ostrich lives. The ostrich usually eats plants, but it will eat lizards and turtles. It also eats much sand and gravel to help grind food for digestion. Ostriches drink water when they find it. But they can live for long periods without drinking if the plants they eat are moist.

Ostriches are *polygamous*—that is, the male has more than one mate. Each *cock* (male) digs a shallow nest in sand, and from three to five *hens* (females) lay their eggs in the nest. Each hen lays as many as 10 eggs. Each egg is almost round, nearly 15 centimetres in diameter, and weighs about 1.5 kilograms. The eggs are a dull yellow and have large pores and a thick shell.

The male sits on the eggs at night. But during the day the dominant hen—which is usually the oldest hen—helps keep them warm. The eggs hatch in about six weeks. When an ostrich is a month old, it can run as fast as an adult. Ostriches can live to about 70 years of age. Few other birds live so long.

Ostrich farming. Hundreds of years ago, great flocks of ostriches roamed over Africa and western Asia. Arabs in western Asia hunted ostriches for sport, and Africans took their eggs for food or killed the birds for their feathers.

In the late 1800's and early 1900's, ostrich plumes became popular as decorations on hats and clothing. Large numbers of ostriches were killed for their plumes, and the birds disappeared from Asia and from much of Africa. Ostrich plumes were in great demand and were so expensive that it became highly profitable to rear ostriches in captivity. Plumes could be taken twice a year from live birds kept on ostrich farms. Ostrich farms were established in Africa, Australia, southern Europe, and the United States. But between 1914 and 1918, fashions changed and the market for ostrich plumes dropped sharply.

Today most ostrich farms are in South Africa and Israel, but a few can be found in the United States. Ostriches are now reared primarily for their skin, which provides fine quality leather to make gloves, shoes, and bags. Ostrich eggs and meat are considered great delicacies in some parts of the world. In addition, ostriches are popular zoo animals because of their unusual appearance and usually mild disposition.

Scientific classification. The ostrich is in the ostrich family, Struthionidae. Its scientific name is *Struthio camelus.*

See also **Bird** (picture: The fastest bird on land).

Ostrogoths. See **Goths.**

© Anthony Bannister, NHPA

A baby ostrich has spotted down that blends with the ground and helps protect the bird from its enemies.

Ostrovsky, Alexander. See **Russian literature** (Early realism).

Ostwald, Wilhelm (1853-1932), a German chemist, writer, and teacher, won the 1909 Nobel Prize for chemistry. He received the award mainly for his studies in surface phenomena and speeds of chemical reactions. Ostwald wrote one of the early books on electrochemistry. His research on the oxidation of ammonia helped Germany make explosives during World War I (1914-1918). Ostwald was born in Riga, Latvia.

Ostwald process. See **Nitric acid.**

Oswald, Lee Harvey (1939-1963), was accused of assassinating John F. Kennedy, president of the United States, on Nov. 22, 1963, in Dallas, Texas. Two days later, while millions of television viewers looked on, Oswald was killed. He was shot to death by Dallas night-club owner Jack Ruby, while being transferred from the city jail to the county jail in Dallas. Ruby pushed through a ring of police officers to shoot Oswald down.

No one saw Oswald shoot the president. The high-powered Italian rifle said to have killed the president was traced to Oswald through a Chicago mail-order firm. Oswald worked in the Texas School Book Depository, the building from which the fatal shots were fired. A worker recalled seeing Oswald carry a long narrow package into the building on the morning of the assassination. Police captured Oswald, who was armed with a revolver, in a Dallas cinema about 90 minutes after the assassination.

Oswald was also charged with killing police officer J. D. Tippit. Tippit was shot to death in Dallas shortly after the president was killed. But Oswald denied killing either Tippit or the president. A presidential commission headed by Chief Justice Earl Warren investigated the case. After a 10-month investigation, the commission reported in September 1964, that Oswald, acting alone, had killed Kennedy and Tippit. However, a congressional committee later reexamined the evidence and concluded that Kennedy "was probably assassinated as a result of a conspiracy."

A Dallas jury convicted Ruby of Oswald's murder in 1964. The conviction was reversed in 1966 on the grounds that the trial judge had allowed illegal testimony. A new trial was ordered, but Ruby died in 1967 before the new trial started.

Oswald was born in New Orleans, U.S.A. Investigators said his school and military records showed emotional difficulty. Oswald dropped out of high school at 17 and joined the U.S. Marine Corps. He was discharged in September 1959 and went to the Soviet Union a month later. He tried to become a Soviet citizen but was turned down. He returned to the United States in 1962 with his Soviet-born wife, Marina.

A few people believed that Oswald never returned to the United States. They maintained that a Soviet agent assumed Oswald's identity and killed Kennedy. But in 1981 Oswald's grave was opened, and a team of medical experts identified the body as Oswald's.

See also **Kennedy, John F.**

Oswestry (pop. 33,600) is a local government district in the northwest part of Shropshire, England. The ancient market town of Oswestry is surrounded by beautiful countryside. Farmers in the area mainly rear dairy cattle. Various light industries also exist in the district. The town of Oswestry dates from Anglo-Saxon times. A church there is dedicated to St. Oswald, the Christian king of Northumbria who ruled during the A.D. 600's. The Welsh sacked the town twice, in 1233 and 1400. Parliamentary forces also attacked Oswestry during the English Civil War of the 1640's. Remains of Offa's Dyke, an ancient earthwork, lie within the district.

Othello. See **Shakespeare, William** (Othello).

Otis, Elisha Graves (1811-1861), was an American inventor who built the first lift with an automatic safety device. The device prevented the lift from falling if the rope that held the lift broke. Otis demonstrated his lift in 1854 in New York City by having the rope cut after he had ascended in the lift. But his invention did not come into wide use until the rise of the skyscraper in the 1870's.

Otis was born in Halifax, Vermont. From 1830 until 1851, he held a variety of jobs that developed his mechanical ability. By 1851, he had become master mechanic at a firm that manufactured bedsteads. The firm sent Otis to Yonkers, New York, in 1852 to supervise the installation of machinery in a new factory. That year, Otis invented the safety lift while building a lift for the factory.

Otitis media. See **Ear** (Diseases).

O'Toole, Patrick (1938-   ), a Fine Gael politician, was the Republic of Ireland's minister for defence and for the *Gaeltacht* (Irish-speaking regions) from 1986 until 1987. Previously, he had been gaeltacht minister from July 1981 to February 1982, and minister for gaeltacht, fisheries and forestry, and tourism from December 1982 until 1986.

O'Toole was a member of Seanad Éireann, the Irish Senate, from 1973 to 1977, when he was elected to Dáil Éireann as the member for Mayo East. He entered politics from teaching and served as a local government representative for a short time.

O'Toole, Peter (1932-   ), a stage and screen actor, achieved one of his greatest successes as Hamlet in the National Theatre's opening production in 1963. In 1959, O'Toole played a soldier in *The Long and the Short and the Tall*, for which he won the Actor of the Year award.

O'Toole's best-known film role is that of T. E. Lawrence in *Lawrence of Arabia* (1962). He also played King Henry II in the film *Becket* (1963). Other films in which he appeared include *The Day They Robbed the Bank of England* (1959), *The Night of the Generals* (1967), *The Lion in Winter* (1968), *Goodbye, Mr. Chips* (1969), *Murphy's War* (1971), *The Ruling Class* (1972), *Zulu Dawn* (1978), *The Antagonists* (1981), *Club Paradise* (1984), and *The Last Emperor* (1986). His television acting performances include *Rogue Male* (1976) *Strumpet City* (1979), and *Kim* (1983).

Seamus Peter O'Toole was born in Galway, Ireland. He studied acting at the Royal Academy of Dramatic Art, in London.

Otosclerosis. See **Deafness** (Diseases).

Otoscope is an instrument that doctors use to examine the eardrum. The otoscope consists of a magnifying lens and a light that is powered by a battery. The light illuminates the eardrum and the lens magnifies it about six times. The otoscope makes it possible for the doctor to see changes in the eardrum resulting from infections and diseases.

Ottawa, Ontario, is the capital of Canada. It lies on gently rolling hills along the south bank of the Ottawa River, about 193 kilometres west of Montreal. Attractive parks, stately government buildings, and scenic drives add beauty to the city.

In 1826, British troops founded the first settlement in the area that is now Ottawa. The soldiers had come to build the Rideau Canal, which links the Ottawa River and Lake Ontario. The town that sprang up around the construction site became known as Bytown. In 1855, the townspeople changed its name to *Ottawa,* an English version of the Algonquian Indian word *adawe,* meaning *to trade.*

Ottawa was a small logging town when Queen Victoria chose it in 1857 to be the capital of the United Province of Canada. The Dominion of Canada was established in 1867, with Ottawa as its capital. The city's layout has been greatly changed through the years in keeping with Ottawa's standing as a national capital.

The city covers 119 square kilometres, including 13 square kilometres of inland water. The Rideau River flows through Ottawa from the south. It plunges 11 metres over a cliff into the Ottawa River at the northeastern end of the city, forming the Rideau Falls. The Rideau Canal cuts through the city on its way from the Ottawa River to Lake Ontario. The city's chief shopping districts centre around the Sparks Street Mall in Upper Town and Byward Market and Rideau Street in Lower Town. The municipalities of Rockcliffe Park and Vanier lie entirely within Ottawa.

The metropolitan area of Ottawa includes Hull. About 3½ million tourists visit the Ottawa-Hull area yearly. They come to see Parliament in action and to view such attractions as the Peace Tower and the eight locks of the Rideau Canal. Ottawa's annual festivals and fairs also attract many visitors.

Facts in brief

Population: 300,763. *Metropolitan area population*—819,263.
Area: 119 km^2. *Metropolitan area*—3,998 km^2.
Climate: *Average temperature*—January, −11° C; July, 21° C. *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—86.97 cm.
Government: Mayor-council. *Terms*—3 years for the mayor and 15 council members.
Founded: 1826. Incorporated as a city in 1855.

Sparks Street Mall, in the Upper Town section of Ottawa, is the heart of one of the city's chief shopping districts.

Annual events in Ottawa include the 10-day Festival of Spring in May. More than 3 million bulbs bloom in parks, along roadways, and on the grounds of public buildings. Former Queen Juliana of the Netherlands sent the bulbs as a gift to Ottawa. During World War II, Juliana, then a princess, lived in Ottawa while German troops occupied her country. After returning home, she sent Ottawa 100,000 tulip bulbs in gratitude for the city's hospitality and for Canada's role in freeing her country. Juliana sent Ottawa 15,000 tulip bulbs for the festival annually until her abdication in 1980. Since 1980, the government of the Netherlands has continued to send the tulip bulbs for the annual festival.

Ottawa holds a nine-day winter festival, called Winterlude, in mid-February. The festival features such sports

The National Arts Centre stands in a landscaped area in the heart of Ottawa. The facility houses a 2,300-seat opera and concert hall and two smaller theatres.

as broomball, car and harness racing on ice, and dogsled racing. The Summer Festival in Lakeside Gardens presents art exhibits, concerts, films, and plays. Every August, the Central Canada Exhibition at Lansdowne Park offers agricultural, industrial, and scientific exhibits. The Ottawa Winter Fair, held every October, also attracts many visitors.

About four-fifths of Ottawa's people were born in Canada. About half of the population have British ancestry, and about a fifth are of French descent. Most of the rest of Ottawa's people trace their ancestry to other European countries. Most Ottawans speak only English, and a small number speak only French.

Industry and commerce. The Canadian government ranks as Ottawa's largest employer. More than 100,000 of the Ottawa area's residents work for the Canadian government. Electronics firms employ thousands of people in Ottawa, as does tourism.

Otter is a member of the weasel family. Otters live close to water and spend much time in it. They are expert swimmers and divers and can stay underwater for three or four minutes. They move awkwardly on land.

Otters live on all the continents except Australia and Antarctica. Most otters weigh from 4.5 to 15 kilograms and grow from about 1 to 1.5 metres long, including the tail. The *giant otter* of South America may measure up to 2 metres long. Otters live along rivers, streams, lakes, and coastal waters, or in marshes. This article is about otters that live in fresh waters. For information about *sea otters,* which live in the Pacific Ocean, see the article on **Sea otter.**

Body. An otter has a small flattened head; a long, thick neck; and a thick tail that narrows to a point. Special muscles enable the animal to close its ears and nostrils tightly to keep water out. Elastic webbing grows between the otter's toes. In most species, the webbing is extensive enough to help the animals swim swiftly.

Otters, like beavers and muskrats, have long coarse *guard hairs* that cover and protect the short, thick underfur. This underfur traps air and keeps the otter's skin dry. In some species, a layer of fat under the skin insulates the otter from the cold. An otter's fur varies in colour from brownish-grey to dark brown when dry, and appears darker when wet.

Otters often use their paws to handle objects. They hold and play skilfully with such things as stones and small shellfish. Some African and Asian species that have only a little webbing between their toes can use the toes like fingers. These otters feed on shellfish that live in shallow water. All otters have claws. Even the so-called clawless otter has short claws on the three middle toes of its hind feet.

The life of an otter. Otters eat crayfish, crabs, and fish. Although otters can sometimes catch such swift-swimming fish as trout, they generally capture slower fish. They also eat frogs, insects, shellfish, snails, snakes, and, occasionally, waterfowl. Otters are active all year round. Where people hunt them, they move about more at night than during the day. They hunt mostly alone, but sometimes they hunt in family groups.

Otters spend much time playing. They wrestle and romp and slide down steep muddy slopes in summer and down icy riverbanks in winter. Otters use a variety of sounds to communicate among themselves. All species have a warning growl. In addition, otters use various kinds of chirps, chuckles, screams, and squeals to express their feelings to other otters. Otters can often be detected by their droppings known as *spraint.*

Most otters make their homes in burrows in riverbanks or under rocky ledges, or in abandoned dens of other animals. Most female otters give birth to two or three young at a time. The babies, called *cubs* or *pups,* are born blind. The young do not swim until they are several months old. People hunt otters for their fur. Certain species, especially the giant otter, are in danger of becoming extinct.

Scientific classification. Otters belong to the weasel family, Mustelidae. The Eurasian otter is *Lutra lutra.* The North American otter is *Lutra canadensis.* The giant otter is *Pteronura brasiliensis.* The clawless and small-clawed otters form genus *Aonyx.* The clawless otter is classified *A. capensis.* The small-clawed otter is classified *A. cinerea.*

See also **Animal** (picture: Animals of the temperate forests).

Otter hound is a breed of dog that was developed in Great Britain for the sport of hunting otters. It has a thick, rough coat, with an oily undercoat that enables it to stay in cold water for long periods. Its feet are slightly webbed, which helps make the dog a good swimmer. A male otter hound stands about 60 to 70 centimetres high at the shoulders, and weighs from 34 to 52 kilograms. Females stand about 55 to 65 centimetres high and

The common otter lives in burrows along the banks of rivers and feeds primarily on fish. The animal is a swift and graceful swimmer but moves awkwardly on land.

The clawless otter has only a little webbing between its toes. The animal can use its toes like fingers. This species of otter feeds on shellfish that live in shallow water.

The otter hound is a hardy dog and a good swimmer.

weigh 30 to 45 kilograms. The otter hound's colour ranges from grizzled blue and white to sand, with black and tan markings.

The breed probably originated during the 1300's. Its ancestry is unclear, but many breeders believe that the otter hound was developed from the Vendee hound of France. Others believe it originally came from the bloodhound.

Otto. See Attar.

Otto was the name of three German kings and emperors, father, son, and grandson. Their combined rule lasted from A.D. 936 to 1002.

Otto I, the Great (912-973), was the first emperor of what later became known as the Holy Roman Empire. He followed his father, Henry I, as king of Germany in 936. Otto's father had actually ruled only his own duchy of Saxony, but Otto tried to rule all Germany. In 951, he crossed the Alps and declared himself the king of Italy. He was forced to return to Germany when the other German princes began a series of revolts. At the same time, the Slavs in Poland and Bohemia revolted, and the Magyars, or Hungarians, invaded Germany. Otto crushed the Magyars in the battle of the Lech River in 955. The Poles and Bohemians were forced to accept his rule. Otto was able to replace most of the rebellious German princes with members of his own family. The young king of Arles, or Burgundy, also had to accept German rule. Otto then turned his attention toward Italy. He married the widow of an earlier Italian king, and defeated a rival for the throne. In 961, Otto crossed the Alps to put down an uprising in Rome. Pope John XII crowned him emperor of what was later known as the Holy Roman Empire (see **Holy Roman Empire**).

Otto II (955-983) was emperor from 973 to 983. He followed his father's example and tried to keep power over Lombardy, Burgundy, Germany, and the Slavic borderlands. Otto II tried to extend his power by claiming several provinces in southern Italy. But the Greek emperor opposed his claim and called on the Muslims to help fight the Germans. Otto was defeated at Cotrone in 982 and left southern Italy. He died in Rome, where he was planning another campaign.

Otto III (980-1002) was 3 years old when his father died, but he was crowned king of the Germans. His mother and grandmother ruled for him as regents. He lived in Italy and took little interest in ruling Germany. He tried to bring back the glories of ancient Rome. His death ended the direct line of Saxon emperors.

Otto I (1815-1867), a Bavarian prince, became the first king of Greece after it was liberated from Turkey in 1830 (see **Greece** [Otto I]). Otto was an unpopular ruler. He was not Greek, and he failed to move toward the realization of the "Great Idea." This idea was to liberate all Greeks still under Turkish rule in such territories as Crete, Thessaly, and Macedonia.

Otto and the Greeks were prepared to join the Russians against the Turks during the Crimean War (1853-1856). Great Britain and France sent troops to Greece and prevented it. The Greeks blamed Otto and deposed him in 1862. Otto, however, worked hard for his people. He rebuilt Athens, established the first Greek university, and refounded Sparta. Otto was born in Salzburg, Austria, on June 1, 1815.

Otto, Nikolaus August. See **Petrol engine** (Development of the petrol engine).

Ottoman Empire was the most powerful empire in the world during the 1500's and 1600's. At its height, it controlled what is now Turkey and parts of northern Africa, southwestern Asia, and southeastern Europe. The empire began about 1300 and lasted until 1922. The Ottomans were nomadic Turkish tribes that migrated to the Middle East from central Asia. The term *Ottoman* comes from *Osman,* also called *Othman,* the founder and first *sultan* (ruler) of the empire.

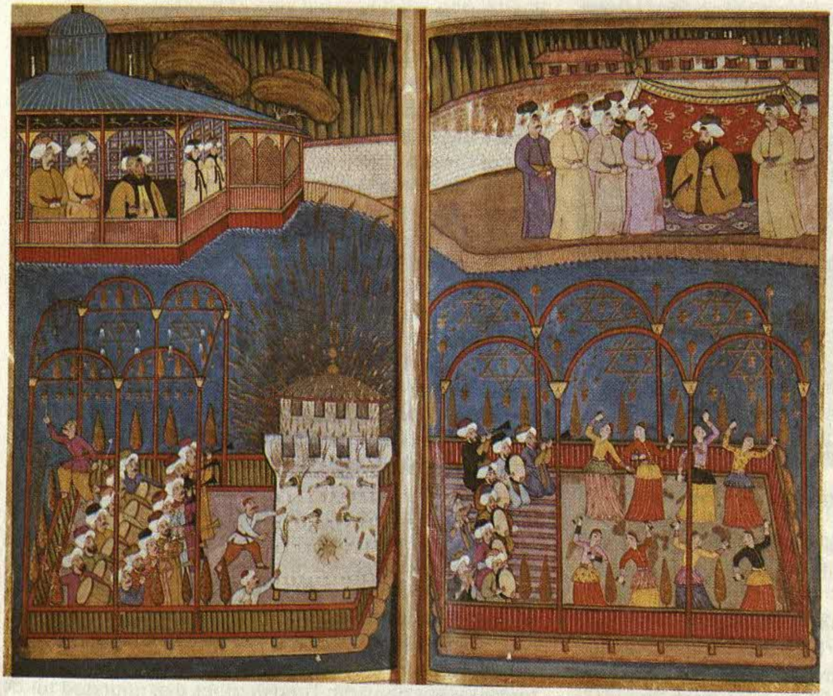
Before the arrival of the Ottomans, the Byzantine Empire had occupied parts of Asia Minor (now Turkey) and southeastern Europe for almost 1,000 years. That empire ended in 1453, when the Ottomans conquered the Byzantine capital of Constantinople (now Istanbul). They made the city their capital. By the mid-1500's, the Ottomans ruled Asia Minor, the Balkans, and parts of northern Africa and present-day Iran, Saudi Arabia, and Syria. The Ottomans were Muslims and they spread their religion, Islam, throughout the empire.

The Ottoman Empire slowly declined during its last 300 years. When World War I began in 1914, the Ottoman Empire consisted of only Asia Minor, parts of southwestern Asia, and part of the Balkans. The Ottomans were defeated in the war, and the empire came to an end in 1922.

Ways of life

People of the Ottoman Empire, in addition to Turks, included many Arabs, Armenians, Greeks, and Slavs. The official language was Ottoman Turkish. The empire had two classes of people. The *ruling class* included the imperial family, owners of large estates, and military and religious leaders. These wealthy people lived in stone mansions. The rest of the people belonged to the *rayah* (protected flock). The sultan had the responsibility of protecting them from invasion and other perils. The rayah had homes of bricks and mud. Most people of both classes dressed in long shirts and baggy, knee-length trousers.

Almost all the women of the Ottoman Empire lived restricted lives. Islamic law permitted a man to have as many as four wives at a time. Muslim women lived most



The Ottomans ruled one of the world's most powerful and wealthy empires. A sultan headed the empire. In this illustration, a sultan, shown in the top left corner, and his court watch elaborate entertainment at a festival honouring several of the sultan's sons.

Illustration about 1720 by Levni from *The Book of the Festivals,* written by Vehbi; Topkapi Palace Museum, Istanbul, Turkey

of their lives in seclusion, usually in a separate section of a household. This section was called a *harem* (see **Harem**). Some women gained power within their harem and had great influence over their husbands and sons. Muslim women also were required to wear veils in public. Many of these restrictions affected non-Muslim women as well.

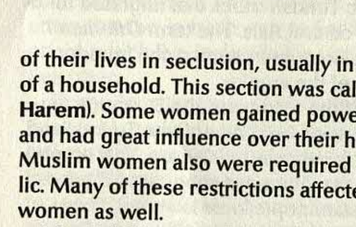
Most Muslims strictly followed the rules of Islam as set down in their holy book, the *Quran* (see **Islam** [Customs and ceremonies]). However, the Ottomans allowed all religious groups to practise their own faiths. Christians and Jews made up the largest non-Muslim groups. Each religious group, including the Muslims, formed a *millet* (nation), whose leader represented its members before the government.

Cultural life. Neighbourhood *mosques* (Muslim houses of worship) served as both religious and social centres for Muslims. Other millets had their own religious ceremonies and social events. The people of the empire also enjoyed carnivals and such sports as archery and wrestling. The Ottomans adopted many styles of Byzantine and Persian art and literature. Major Ottoman contributions came in the fields of architecture, carpet weaving, and tile making.

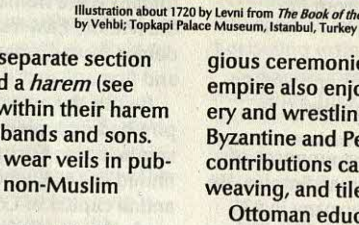
Ottoman education emphasized religious studies. Beginning in the 1300's, boys attended schools in the mosques. The most able students went on to secondary schools called *medreses.* Girls began to go to primary school in the mid-1800's.

Economy. Most of the people of the Ottoman Empire worked as farmers. Grain was grown in fertile areas of Egypt, Syria, and lands surrounding the Black Sea. Craftworkers and merchants practised their trade in the cities and towns.

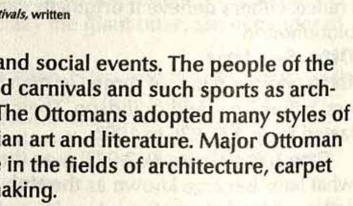
The Ottoman Empire gained great wealth through trade. Some of the busiest trade routes between Asia



The Ottoman Empire started as a small state around Bursa in Anatolia (now Turkey). By the late 1400's, the empire had expanded into Eastern Europe.



During the 1600's, it was the world's largest empire. It had its capital in Istanbul and covered parts of Eastern Europe, the Middle East, and North Africa.



The empire declined in the 1700's and 1800's and collapsed during World War I (1914-1918). Turkey was formed in 1923 from the remaining territory.

and Europe ran through the empire. Merchandise offered in the markets of Ottoman cities included Chinese porcelains, European woollens, Persian silks, and spices from Asia.

Government. The Ottoman sultans made all important governmental decisions for the empire. The sultans appointed officials to collect taxes and to keep peace within the empire.

The powers of the sultans were limited in some ways. For example, the rulers needed the support of the army to maintain their position. In addition, new laws were subject to the approval of the empire's chief religious judge, the *grand mufti,* before they could take effect.

Portrait (about 1480) by Sinan Bey; Topkapi Palace Museum, Istanbul, Turkey

Sultan Muhammad II, also called the Conqueror, added much of southeastern Europe to the Ottoman Empire. His armies conquered the Byzantine capital of Constantinople in 1453.

After the death of a sultan, he was succeeded by his oldest son or by a favourite son whom he had chosen. Some sultans eliminated threats to their rule by murdering their brothers or confining them to the royal palace.

History

The beginning of the empire. The Turkish tribes led by Osman settled in the province of Anatolia (now Turkey) during the late 1200's. The tribes captured the city of Bursa in 1326 and then began to attack the surrounding territory, including the Byzantine Empire. In the late 1300's, the Ottomans formed a group of highly trained, professional soldiers called *Janissaries* (see **Janissaries**).

Expansion and decline. By the mid-1400's, the Ottomans had conquered the entire Byzantine Empire except for the city of Constantinople. Ottoman troops, led by Sultan Muhammad II, captured Constantinople in 1453. The city then became the centre of the Ottoman Empire.

Under Muhammad II, or Mehmed II, the Ottomans also conquered much of southeastern Europe and territory near the Black Sea. They took over Syria in 1516 and Egypt in 1517. The empire reached its peak of power and wealth under Sultan Suleiman I, who ruled from 1520 to 1566. His armies conquered Hungary, northern Africa, and territory on the east coast of the Red Sea down to what is now Yemen.

In 1571, naval forces from Spain, Venice, and the Papal States of Italy almost destroyed the Ottoman fleet in the Battle of Lepanto. But the navy was rebuilt and the empire continued to grow. In 1683, Austrian and Polish troops turned back an Ottoman attack on Vienna, Austria. This defeat ended the empire's territorial expansion. During the next 200 years, many nations won independence from Ottoman rule. Government corruption, inflation, and weak sultans also contributed to the decline of the empire.

The empire ends. In 1908, a group of Ottoman military officers called the Young Turks forced Sultan Abdul-Hamid II to restore the empire's constitution, which guaranteed an elected parliamentary government. The constitution had been adopted under Abdul-Hamid in 1876, but he suspended it the next year following a Russian invasion.

After World War I ended in 1918, troops of several Allied nations, including Greece and the United Kingdom, occupied the Ottoman Empire. The empire's forces had supported Germany in the war. A Turkish military hero named Mustafa Kemal (later called Kemal Atatürk) led a nationalist movement that ended the occupation of Turkey in 1922. The Turkish government abolished the Ottoman Empire that year and created the Republic of Turkey in 1923.

See also **Atatürk, Kemal; Muhammad II; Muslims** (The Ottoman Turks; Colonialism); **Suleiman I; Turkey** (History).

Otway, Thomas (1652-1685), was an English Restoration dramatist. His first play, *Alcibiades,* was produced in 1675. He is best remembered for his tragic play *Venice Preserved* (1682), which has remained popular until the present day. His other important tragedy is *The Orphan* (1680). Both plays are in blank verse. Otway was born in Trotton, in West Sussex.

Ouagadougou (pop. 442,223) is the capital and largest city of the West African republic of Burkina Faso. For location, see **Burkina Faso** (political map). The city has a modern central district and numerous *mosques* (Islamic houses of worship). The palace of the Moro Naba, the traditional leader of the country's Mossi people, is also in the city. Ouagadougou has an airport, a university, and a museum of African art. Its industries include food-processing, the bottling of beverages, and the production of building supplies and textiles.

Ouagadougou was probably founded in the 1100's. In the mid-1400's, it became the Moro Naba's capital. French forces captured the city in 1896. Ouagadougou grew little until 1954, when a railway connected the city with Bobo Dioulasso and the Ivory Coast. Since then, many people have moved to the city in search of work.

Oubangui River. See **Ubangi River.**

Oudtshoorn (pop. 33,480) is a tourist resort in the Western Cape province of South Africa. It is known as "the ostrich feather capital of the world." Between 1880 and 1915, there was a worldwide fashion for wearing ostrich feathers as decoration for hats and clothing. During this boom period, local farmers kept more than 750,000 ostriches. Today ostrich farmers keep about 150,000 birds. But they are reared mainly for their skins, which are made into leather. Farmers in the district now

A ouija board is used as a game or to supposedly exchange messages with the spirits of the dead.

grow alfalfa, cereals, fruit, tobacco, vegetable seed, and walnuts. Dairy produce, honey, and wine are also important.

The town was laid out in 1847. It was named after Baron Pieter van Reede von Oudtshoorn, who died in 1773 on his way to take up the post of governor of the Cape Colony.

Ouija board is a device used to supposedly ask questions of the spirits of the dead and receive answers from them. People who believe seriously in the Ouija board use it at gatherings called *séances.* Others use the Ouija board for fun as a game.

A Ouija board is a small board with various symbols printed on its surface. These symbols include the letters of the alphabet, the numbers from 1 to 9 and 0, and the words *yes* and *no.* A smaller, three-legged board serves as a pointer.

Two or more people hold a Ouija board on their laps and press their fingers lightly on the pointer. One of them asks the board a question. The pointer supposedly answers by indicating a word or a number or by spelling out words. According to people who believe in the Ouija board, spirits guide the pointer. Others think the fingers of the questioner influence the pointer. The Ouija board was invented about 1890 by William Fuld of Baltimore, U.S.A. Its name comes from the French word *oui* and the German word *ja,* both of which mean *yes.*

Ounce. See **Snow Leopard.**

Ounce is a measure of weight and of volume. In *avoirdupois* weight, the ounce is equal to one-sixteenth of a pound, or 437½ grains (28.3495 grams). In *troy* weight and *apothecaries'* weight, the ounce is equal to one-twelfth of a pound, or 480 grains (31.1035 grams). Grains are the same in all these systems. The avoirdupois ounce is used in weighing ordinary merchandise, such as foodstuffs in the United States, the United Kingdom, and some other countries. The troy ounce is used in weighing precious metals. The apothecaries' ounce was once used in compounding prescriptions. The name *ounce* comes from the Latin word *uncia,* meaning a *twelfth.*

In liquid measure, one fluid ounce equals 29.5735 millilitres. There are 16 fluid ounces in a liquid pint. The fluid ounce based on the imperial gallon equals 28.4131 millilitres. Twenty ounces make a pint in the imperial system.

See also **Weights and measures; Apothecaries' weight.**

Our Lady of Guadalupe. See **Guadalupe Day.**

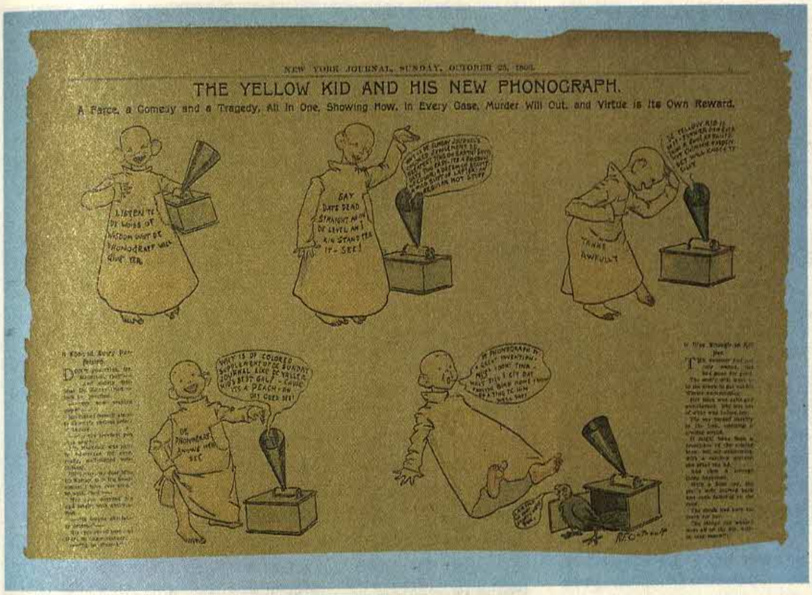
Ouse is the name of four major rivers in England. The Great Ouse rises in Northamptonshire and flows for 260 kilometres through the counties of Buckinghamshire, Bedfordshire, Cambridgeshire, and Norfolk, until it reaches the Wash. It flows past the towns of Bedford, Huntingdon, Ely, and King's Lynn. The Little Ouse, about 40 kilometres long, meanders mostly along the boundary between the counties of Norfolk and Suffolk and flows into the Great Ouse.

The main part of the Yorkshire Ouse is 72 kilometres long and is formed by the convergence of two rivers, the Ure and Swale, that flow from the Pennine Hills. The Yorkshire Ouse then joins the Trent to form the Humber estuary. The Sussex Ouse, about 50 kilometres long, flows into the English Channel at Newhaven.

Outboard motor is a petrol or electric motor attached to the stern of a boat. The motor operates a vertical driving shaft to which a propeller is geared. The propeller spins underwater to propel the boat.

Petrol outboard motors are the most frequently used

An outboard motor is attached to the stern of a boat. Such motors are powered by electricity or petrol engines.


NEW YORK JOURNAL, SUNDAY, OCTOBER 25, 1896.
THE YELLOW KID AND HIS NEW PHONOGRAPH.
A Farce, a Comedy and a Tragedy, All in One, Showing How, in Every Case, Murder Will Out, and Virtue is Its Own Reward.

Outcault's "The Yellow Kid" was the first comic strip to gain widespread popularity. It featured a bald, grinning boy who became involved in humorous situations connected with New York City. The illustration at the left is the first "Yellow Kid" comic strip, which appeared in the *New York Journal* in 1896.

type of outboard motor. Such motors may have either horizontal or "V-shaped" cylinders. There may be one, two, three, four, six, or eight cylinders in a petrol outboard motor. Electric outboard motors are used less frequently because their power comes from storage batteries that must be recharged often.

Outboard motors operate at high speed and deliver their full power at 4,000 to 6,000 revolutions per minute. Some of the smaller types of outboard motors are also designed for low speeds and are used to fish by *trolling*—that is, by trailing a fishing line behind a moving boat. See also **Motorboat racing.**

Outcault, Richard Felton (1863-1928), was an American cartoonist. He created the first comic strip that gained widespread popularity. This weekly strip, called "Hogan's Alley," first appeared in 1895 in *The World,* a New York City newspaper. The strip quickly became an immense success.

The main character of "Hogan's Alley," a boy named Mickey Dugan, wore a long gown that, beginning in early 1896, was coloured yellow. As a result, the character became known as the Yellow Kid. Later in 1896, "Hogan's Alley" was renamed "The Yellow Kid." Still later that year, Outcault accepted an enormous salary from the *New York Journal* to draw the strip for it. *The World* hired another artist to draw "The Yellow Kid," and the papers began an intense rivalry. Other newspapers called them the "Yellow Kid journals." The term *yellow journalism,* meaning a highly sensational kind of newspaper writing, thus began with "The Yellow Kid" comic strip. Outcault was born in Lancaster, Ohio.

Richard Outcault

Outer Mongolia. See **Mongolia.**

Outlaw. See **Bandit** with its list of *Related articles.*

Outline is a short summary of the main topics or principal ideas of a written work or a speech. A good outline serves as a useful tool for a reader or a writer. A reader can outline written material to discover the structure of the author's argument and to determine its strengths and weaknesses. Outlining is thus a valuable way to summarize articles and books and to study them critically.

A writer uses an outline primarily to organize ideas about a subject. The procedure for making such an outline is the same, whether the outline is short and simple or long and complicated. First, list the important points about the subject. Next, classify the items on the list into meaningful groups. Then decide on a method of organizing the groups to present the information clearly and effectively. For example, move from the least important to the most important points or from arguments in favour of a position to arguments against it so that the work progresses to a climax.

Outlines used as a plan for writing may be either *formal* or *informal.* In either type of outline, the writer must observe the proper principles involved in selecting, classifying, and arranging material.

A formal outline may take the form of a *topic outline* or a *sentence outline.* A topic outline summarizes the chief topics and subtopics of the piece in brief phrases. A sentence outline uses complete sentences for each topic and subtopic.

Most formal outlines have a thesis statement that identifies the argument or subject of the outline, followed by topic headings and indented subheadings. Identify all main headings with Roman numerals. Label subheadings with capital letters, Arabic numerals, and small letters, in that order. If more subdivisions are needed, use numbers and small letters in parentheses. Begin the first word of each topic and subtopic with a capital letter.

Outriggers in some countries are used on small boats called *shells, left.* These outriggers are brackets that extend from each side of the shell and hold the oarlocks away from the boat. The extended oarlocks increase the shell's speed by giving the rower greater leverage.

Here is an example of a topic outline:

Thesis statement: There are better reasons for not buying a car than for buying one.

- **I. Reasons for buying a car**
  - A. Convenience
  - B. Status
- **II. Reasons for not buying a car**
  - A. Inconvenience
    - 1. High cost of fuel
    - 2. Increasingly crowded roads
    - 3. Parking a growing problem
      - a. Urban areas unpredictable
      - b. Weather unpredictable
  - B. Hazards
    - 1. Road systems inadequate
    - 2. Possibility of accidents
  - C. Poor financial investment
    - 1. Initial investment
      - a. High taxes
      - b. High interest rates
    - 2. Continuing investment
      - a. Fuel
      - b. Equipment
      - c. Maintenance
      - d. Fees to government departments

Other examples of topic outlines may be found in *World Book* at the end of such articles as **United Kingdom, Bird,** and **American literature.**

Many teachers of writing believe that an informal outline is more valuable to a writer than a formal outline. They feel that the formal outline's emphasis on strict form and structure can interfere with a writer's ability to evaluate what he or she knows about a topic.

An informal outline may consist of no more than rough notes intended to suggest the major points to be covered in the composition. An informal outline may also consist of sentences or partial paragraphs that can be numbered or cut out and pasted together to form a logical sequence.

Outriggers in the Philippines have a large framework that extends from each side of a canoe. The framework supports a pole that floats parallel to the boat and keeps it from capsizing in rough coastal waters. The double outriggers shown above provide maximum support.

Outrigger boat is a rowing boat with the rowlock mounted on *outriggers* (brackets) which run out from the sides of the boat. The leverage that the rower puts on the oars is increased when the rowlocks are farther away. Outriggers are rarely used except in "shells," or very light boats such as are used in interclub boat racing. In the Indian and Pacific oceans, an "outrigger" is a canoe with a log attached to a framework extending from one side. The log is a counterbalance and keeps the canoe from capsizing. Some outriggers can hold 30 people. See also **Catamaran.**

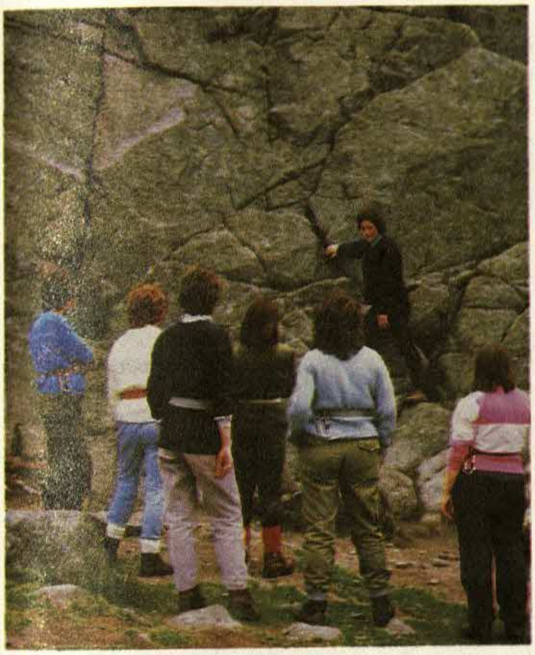
Outward Bound Trust runs a group of schools in Britain designed to strengthen the character of young people through adventure. The trust also helps other countries to set up their own schools. The trust's schools give an opportunity for young people from a wide range of backgrounds to meet and work together. For example, industrial apprentices, as well as students from independent schools, take the schools' courses. During these courses, they can learn seamanship, rock climbing, canoeing, and various forms of life-saving, and take part in all kinds of athletics.

The Outward Bound Trust has two centres in Wales, two in the Lake District, in England, and one in Scotland. There are also centres in Australia, Kenya, Malaysia, New Zealand, Nigeria, and Zambia.

The first centre was set up in 1941 at Aberdovey, in Gwynedd, Wales. It was established by Kurt Hahn, a German educationist, and by Lawrence Holt, the head of a steamship company. The trust was set up in 1946.

Oval, The. See **Cricket** (Famous cricket grounds).

Ovary is either of a pair of female sex organs that store and release eggs. The ovaries also secrete *oestrogens* and *progesterone,* the female sex hormones. The human



Outward Bound courses give young people an opportunity to learn new skills, such as rock climbing. The courses help students develop self-reliance through outdoor activities.

ovary is oval in shape and about the size of an unshelled walnut. One ovary is located on each side of the uterus, at the base of the abdomen.

Eggs are released from the ovaries only during the childbearing years. During the first half of each menstrual cycle, one of the eggs stored in the ovaries matures. Also during this time, the ovaries release oestrogens, which cause the lining of the uterus to thicken in preparation for pregnancy. *Ovulation* (the release of the mature egg) occurs about midway through the menstrual cycle. After ovulation, the ovary that releases the egg secretes progesterone, which maintains the uterine lining, as well as oestrogens. If the egg is fertilized, a pregnancy begins. The ovary and *placenta*—an organ that develops early in pregnancy—secrete progesterone and other hormones, and the menstrual cycle stops until after the baby has been born. If the egg is not fertilized, the ovary stops producing progesterone about 14 days after ovulation. The egg and the uterine lining then pass out of the body during menstruation.

Between the ages of 45 and 50, most women stop menstruating and enter a period called *menopause*. The ovaries gradually stop functioning and shrink to about the size of a pea.

See also **Menopause; Menstruation; Progesterone; Reproduction.**

Oven. See **Cooking** (Methods; History).

Ovenbird refers to two types of American birds that build domed nests. The *rufous ovenbird* of tropical and South America is a reddish brown thrushlike bird that builds a rounded mud nest shaped like an old-fashioned baker's oven. The other common name for this bird is *honero* which is Spanish for baker. The rufous ovenbird builds its nests in open country, often on gateposts on the extensive cattlelands of the *pampas* (South American grassland).

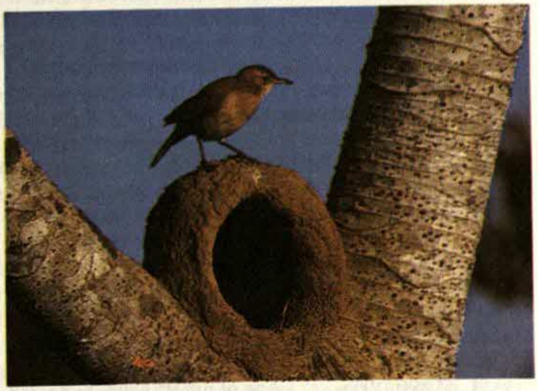
Outward Bound gives young people a chance to put new skills into practice. The challenge of climbing, *above*, helps participants conquer their fears and develop their character.

The other species of ovenbird is a North American warbler that builds a domed nest of grasses on the ground. It is like a small thrush, olive-green with a streaked breast. Other birds, such as the wood warbler, also build dome-shaped nests, mainly of grasses, on the ground.

Scientific classification. The rufous ovenbird belongs to the family Furnaridae. It is *Furnarius rufus*. The North American wood warbler belongs to the family Parulidae. It is *Seirus aurocapillus*.

See also **Warbler.**

Overland telegraph runs across Australia for 3,568 kilometres from Adelaide to Darwin, where it joins telegraphic links with Asia and Europe. The first Overland telegraph joined Port Augusta, in South Australia, and



The ovenbird gets its name from its ovenlike clay nest.

Port Darwin, in the Northern Territory. Work on it began in 1871 and was completed the next year after much difficulty. A submarine cable from Darwin to Java also came into operation in 1872.

Overlanders is an Australian term for men who drive sheep or cattle long distances through undeveloped country. Early overlanders, like Charles Bonney and Joseph Hawdon, followed in the path of the explorers. Others, such as the Archer and Jardine brothers, explored and opened up new territory in Queensland.

Related articles in *World Book* include:

Ainslie, James
Archer
Bonney, Charles
Durack
Hawdon, Joseph
Jardine

Overpopulation. See **Population; Birth control; Ehrlich, Paul R.**

Overtone. See **Harmonics.**

Overture is an instrumental composition that introduces a longer musical work, especially an opera. Some overtures, called *concert overtures,* are always performed as independent compositions.

The first overture was written in the 1660's by the French composer Jean Baptiste Lully. Lully opened his operas and ballets with *French overtures,* which were short pieces consisting of three sections. The first section was slow, the second was lively, and the third was often the climax.

In the 1690's, Alessandro Scarlatti, an Italian composer, developed the *Italian overture,* also called the *sinfonia.* It consisted of three movements, of which the first was lively and written in the sonata form (see **Sonata**). The second was slow, and the third extremely fast. The Italian overture had an important role in the development of the symphony.

Overtures were revolutionized during the 1700's by the German-born Christoph Willibald Gluck and Wolfgang Amadeus Mozart of Austria. Gluck became the first major composer to use an overture to put the audience in the proper mood for an opera. Previously, the overture had no direct connection with the opera that followed it. Mozart continued Gluck's ideas and established the overture as a single movement. The overtures written by Mozart served as models for overtures to future operas.

During the 1800's, opera overtures were often performed separately at concerts. These performances inspired composers to write concert overtures, most of which were short pieces that musically told a story or set a mood. Popular concert overtures include the "1812" (1880) by Peter Ilich Tchaikovsky of Russia and the *Academic Festival* (1880) by Johannes Brahms of Germany. During the 1900's, many concert overtures have been written for school orchestras and bands.

The concert overtures composed by Felix Mendelssohn of Germany during the 1820's and 1830's led to the development of the *symphonic poem* in the mid-1800's (see **Symphonic poem**). Another German composer, Richard Wagner, avoided the traditional overture in his operas of the mid-1800's. He used an orchestral piece called a *prelude* that led directly into the first scene of an opera.

Overweight. See **Diet; Health** (Elements of physical health); **Weight control.**

Ovett, Steve (1955-), one of Britain's greatest track athletes, won fame for his record-breaking successes and his rivalry with another British athlete, Sebastian Coe. In the 1980 Olympic Games at Moscow, Ovett won a gold medal in the 800 metres and a bronze in the 1,500 metres, in which Coe beat him to first place. In the same year, Ovett set a world record in the mile at Oslo, Norway, and for the 1,500 metres at Koblenz, West Germany. He set another world record for the 1,500 metres in 1983.

Steven Michael James Ovett was born in Brighton. He studied art before taking up athletics full time. He set his first record in 1970 when he won the English Schools Junior Boys 400 metres. In 1973 he won the European junior 800-metres title, and also ran his first four-minute mile.

Ovid (43 B.C.-A.D. 17?) was a great Roman poet. He became best known for his witty and sophisticated love poems.

Perhaps Ovid's most famous work is the *Art of Love,* which is a kind of manual in verse on how to find and keep a lover. It consists of three books, two addressed to men and one to women, and all written in a humorous, satirical style.

Ovid believed that the *Metamorphoses* was his greatest work. It is a narrative poem beginning with the creation of the world and ending in Ovid's time. The poem describes the adventures and love affairs of deities and heroes, with more than 200 tales taken from Greek and Roman legends and myths. Many of the stories involve a *metamorphosis* (transformation), such as the transformation of a woman into a bird. For information about some of the stories, see **Arethusa; Narcissus; Pygmalion;** and **Pyramus and Thisbe.**

Ovid's other poems include the *Heroides (Letters of Heroines)* and the unfinished *Fasti (The Calendar).* The *Heroides* consists of 21 imaginary letters between famous women of mythology and their husbands or lovers. The *Fasti* deals with Roman religious festivals and customs and anniversaries of historical events.

Ovid was born in Sulmona, Italy. His full name was Publius Ovidius Naso. In A.D. 8, Emperor Augustus banished Ovid to an isolated fishing village on the Black Sea. Ovid's many poems pleading to return to Rome were ignored, and he died in exile.

See also **Latin literature** (The Augustan Age).

Oviparous animal is an animal that reproduces by means of fertilized eggs that develop outside of the mother's body. In *viviparous* animals, eggs are fertilized and develop inside the parent. Most *vertebrates* (animals with backbones) are oviparous, although there are exceptions. For example, certain types of fish, sharks, lizards, and snakes, and all mammals except for the platypus and the echidna, are viviparous.

See also **Viviparous animal.**

Ovoviviparity. See **Reproduction** (Sexual reproduction in animals).

Ovulation. See **Reproduction** (Human).

Ovule. See **Flower** (The pistils; Fertilization).

Owen is the family name of two social theorists, father and son.

Robert Owen (1771-1858), a Welsh-born social reformer, pioneered in cooperative movements. He tried to prove as a businessman that it was good business to think of the employees' welfare. He set up the famous New Harmony community in Indiana, U.S.A., in 1825.

Owen was part owner and the head of the New Lanark cotton mills in Scotland in 1799. It was during the Industrial Revolution, when machines were replacing home sewing and weaving. New factories were rarely built with the comfort of the workers in mind. Wages were low, and women and children were not treated with consideration.

Robert Owen

He organized a model community. Instead of employing children, he built schools for them. He kept his mills in good repair, and tried to take care of his labourers' needs. The success of his mills impressed many visitors.

New Harmony. Owen wrote on the subject of proper social conditions, and tried to interest the British government in building "villages of cooperation." He thought these villages ought to be partly agricultural and partly industrial. He made up his mind to show they could succeed. He then set up New Harmony.

Owen believed in equal opportunity for all. His ideas in education were influenced by Johann Pestalozzi, a Swiss educator. Owen opposed mere book learning. He believed children also could be taught "correct ideas" by surrounding them with good examples. He lost popularity by his antireligious views. Many of his associates at New Harmony refused to work. The community failed in 1827, and Owen returned to England.

Cooperatives. Owen retired from business to devote all his time to his social theories. He lived in London in 1828. There, trades unions became interested in his "villages of cooperation." In 1833, Owen organized the Grand National Consolidated Trades Union. It had more than 500,000 members. The movement tried to reorganize industry into cooperatives. The government and manufacturers opposed it, and by 1834, the union had collapsed. Owen continued to write and agitate for government aid. Although his plans were not accepted, his ideas influenced all later cooperative movements.

Owen was born in Newtown, Wales. He left school when he was 9 to work as a cotton spinner.

Robert Dale Owen (1801-1877) was a Scottish born social theorist and an American legislator. He worked with his father, Robert Owen, in the New Lanark and New Harmony model communities. He edited the New Harmony *Gazette* with Frances Wright. When New Harmony collapsed in 1827, Owen moved to the United States. He and Frances Wright edited the *Free Enquirer* and tried to organize the Workingmen's Party in 1829 in New York.

Owen was elected to the Indiana state legislature in 1836 and served until 1838. He was a member of the U.S. House of Representatives from 1843 to 1847. He served as Minister to Naples from 1855 to 1858. Owen championed emancipation for black slaves, and influenced President Abraham Lincoln's views. He was a freethinker in religion, and a pioneer in advocating birth control and universal education. He was born in Glasgow, Scotland.

Owen, David (1938-   ), is a British politician who led the Social Democratic Party (SDP) from 1983 to 1987. He resigned as leader after SDP members voted to merge with the Liberal Party (now the Liberal Democrats). The Liberal Party and the SDP had been partners as the Alliance in two general elections. A founder of the SDP, Owen strove to preserve the party's independence. He became leader of a re-formed SDP in 1988, until its dissolution in 1990.

David Owen

Owen had been secretary of state for foreign and commonwealth affairs in a Labour government from 1977 to 1979. In 1981, following internal disputes within the Labour Party, Owen resigned.

Owen entered Parliament in 1966 and held posts in various Labour governments in the Ministry of Defence and Department of Health and Social Security. David Anthony Llewelyn Owen was born at Plympton, Devon. He studied medicine at Cambridge University and London. He received a life peerage in 1992.

Owen, Goronwy (1728-1769?), was a Welsh poet and clergyman. He is best remembered for his verses in the strict metre of the Welsh *cywydd* (a type of ode). These poems show Owen's mastery of the Welsh language and his purity of style. Best known are his early works *Calendr Y Carwr* (*The Lover's Calendar*) and *Cywydd Y Farn Fawr* (*Ode on the Last Judgement*). Owen was born at Rhos Fawr, Anglesey, Gwynedd. He attended Oxford University and served as curate and schoolmaster in Shropshire and London. From 1760 until his death, Owen taught at Williamsburg, in Virginia, U.S.A.

Owen, Wilfred (1893-1918), was a British World War I poet. His collection of poetry *Poems* (1920) places him high among the soldier poets. His poetry reflected with painful clarity the agony and ugliness of war. In Owen's verses, *assonance*, rather than rhyme, creates the poetic effect. Assonance is characterized by combinations of words that have like vowel sounds and different consonant sounds. A complete edition of his 59 poems was published in 1931, with notes by Edmund Blunden. In 1962, the composer Benjamin Britten incorporated some of Owen's powerful verse into his *War Requiem.*

Owen was born in Oswestry, Shropshire. He was educated at the Birkenhead Institute and London University. He was killed in action in France in 1918, only a week before the war's end.

Owen Gun was an Australian-designed and manufactured submachine gun. It was used by the Australian Army from World War II until the early 1960's.

The Owen Gun was invented by E. E. Owen of Wollongong, New South Wales, who had produced a prototype in July 1939. Lysaght's Newcastle Works agreed to help with its development, and after tests, an initial order was received for 100 guns. But the results of later tests were so favourable that the first quantity was increased to 2,000. Delivery of the Owen Gun began early in 1942.

The Owen Gun had a magazine that held 32 rounds, but it could be fired at a rate of 800 rounds per minute. It was usually used to fire a burst of two or three rounds, or single shots. It weighed 5 kilograms and could be fired from the shoulder or the hip.

Owens, Jesse (1913-1980), was an American athletics star. His performances during the mid-1930's in college and in the Olympic Games made him one of the most famous athletes in sports history.

Owens won four gold medals at the 1936 Summer Olympic Games in Berlin, Germany. He won the 100-metre and 200-metre races and the broad jump (now called the long jump), and he was a member of the winning American 400-metre relay team. He set Olympic records in the 200-metre race and in the broad jump. The performance of Owens, who was black, was embarrassing to Adolf Hitler, the ruler of Germany. Hitler and his followers were hoping that German athletes would prove that the *Aryans*—a term they used for Germans and certain other peoples of northern Europe—were superior to all other peoples.

Owens was born in Oakville, Alabama. His real name was James Cleveland Owens. His nickname, Jesse, came from his initials, J. C. Owens was the son of a tenant farmer. At the age of 7, he moved with his family to Cleveland. Owens excelled in athletics while attending Ohio State University from 1933 to 1936. At a college meeting in Ann Arbor, Michigan, in 1935, he broke three world records and equalled a fourth within 45 minutes. Owens set seven world records during his career.

Jesse Owens

Owens eventually went into the public relations business. He worked in community service, especially youth work. Owens believed that athletic competition could help solve racial and political problems.

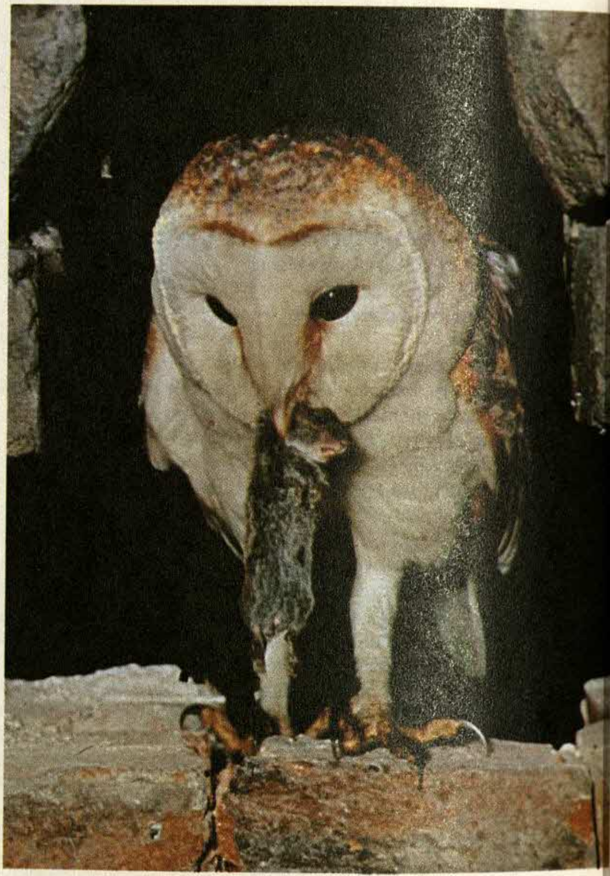
See also **Olympic Games** (picture: Jesse Owens).

Owl is a type of bird that usually lives alone and hunts for food at night. The owl has been called the "night watchman of our gardens" because it eats harmful rodents at night. Although it is a bird of prey—that is, a bird that kills and eats other animals—it is not thought to be closely related to other birds of prey.

Scientists have identified about 145 species of owls. Owls live throughout the tropical, temperate, and subarctic regions of the world, and they can be found on many oceanic islands.

The smallest species of owl is the tiny *elf owl* of the southwestern United States and western Mexico. It measures about 15 centimetres long. The largest species is the *great grey owl,* which lives in the deep woods of Canada and Alaska as far north as trees grow. It measures about 75 centimetres long and has a wingspan of 137 to 152 centimetres.

Appearance. A person can recognize any owl at once by its large, broad head with a saucer-shaped ruff of feathers around the eyes. This ruff is called the *facial disc.* It serves to reflect sound to the owl's ear openings. In some species, the facial disc and the ear openings are very large. The eyes of most owls are large and are directed forward, unlike the eyes of most birds. For this reason, owls can watch an object with both eyes at the same time. Like people, they have binocular vision. But unlike people, owls cannot move their eyes in their sockets. Thus, they must move their heads to watch a moving object. Owls have long lashes on their upper eyelids, which they can close over the eyes. Owls' eyes make them look wise, and so the owl has long been a symbol of wisdom. The ancient Greeks believed the owl was sacred to Athena, their goddess of wisdom. Actually, blue jays, crows, jackdaws, and many other birds are probably more intelligent than owls.



The common barn owl nests in abandoned buildings. It aids farmers by helping to keep farms free of rats and mice.

Owls have short, thick bodies; strong, hooked beaks; and powerful feet with sharp claws called *talons.* Some owls have tufts of feathers on their heads. The tufts are often called "ears" or "horns." The feathers of owls are long, soft, and fluffy, and often make the birds seem larger than they are. The plumage is usually dull-colored, so that the bird may blend in with its surroundings.

Way of life. Owls can fly fairly fast. Their feathers muffle the swishing sound that most birds make when they fly. An owl can swoop down on its prey unheard. Some owls can see well enough in the daytime to hunt by day as well as by night. Other owls hunt only at night. Most night-hunting owls have keen vision in the dark. However, some owls have such sensitive hearing that they rely very little on vision. These owls can locate and catch mice, voles, and other small mammals in total darkness by listening to the rustling noise the mice make running through leaves on the forest floor.

Owls eat mostly mammals. The larger owls catch rabbits and squirrels, and the smaller ones catch many mice, rats, and shrews. Owls usually capture their food alive, but now and then they pick up animals that have been recently killed along roadsides. Some owls also hunt a few birds and insects. Other owls have been known to take fish from shallow waters. Like hawks, owls tear large prey into pieces when they eat it. But if the prey is small enough, they swallow it whole. They later cough up pellets of bones, fur, scales, and feathers, which they cannot digest. These pellets can be found under their nests and roosting places.

Owls are among the most useful birds to farmers. They destroy harmful rodents, such as voles and rats, and also rabbits, which often damage crops. They seldom take poultry, which are usually asleep and inside when owls come out to hunt.

Owls do not build elaborate nests. Their nests are usually old nests of hawks or crows, or crude structures in hollow trees, caves, underground burrows, barns, deserted houses, or belfries. Most female owls lay 3 or 4 eggs, but some lay as few as 1 or as many as 12 eggs. The eggs are nearly round and are white tinged with buff or blue.

Both male and female owls help to care for their eggs and young. Young owls have a covering of thick white down. They stay in the nest for 10 to 12 weeks. The larger owls defend the nests against intruders. They sometimes injure people with their talons.

Kinds of owls. There are two families of owls: *barn owls* and *typical owls.* There are 10 species of barn owl. They live in most places except the colder regions. The barn owl has a widespread distribution. It is found between latitudes 40° north and 40° south, extending northward into northwestern Europe, and southward to the tip of South America. The common barn owl is about 46 centimetres long. The common barn owl usually nests in a cave or hollow tree. It also may nest in a belfry or the dark places in a barn, which gives it its name. In parts of Europe, farmers install special "owl doors" on their farm buildings to encourage barn owls to nest. Small owls tend to prey on insects.

The *burrowing owl* of the Americas lives in open, grassy country. In North America, they often nest in the abandoned burrows of prairie dogs. Burrowing owls have long legs which helps them move over the ground, and they can see well in the daytime. They live mainly on insects but also on small mammals including young prairie dogs. The burrowing owl has a chattering note.

The Eurasian *eagle owl* and its North American counterpart, the *great horned owl,* are large, powerful birds, up to 70 centimetres long, with ear tufts and orange eyes. They live in wild, rocky desert and forested areas. They can take prey as large as young deer, hare and game birds.

Fishing owls are powerful birds with a large, strong bill. The legs are generally unfeathered and the feet are covered with rough scales, used to grip fish that they prey on. There are several species that live in Africa and Asia. They hunt mainly at night.

The *great grey owl* is one of the world's biggest owls.

Some kinds of owls

Owls are good hunters. They see and hear well and can fly almost noiselessly. Many owls build their nests in hollow trees. Others nest on ledges of cliffs or in burrows in the ground. Owls are helpful to people because they eat mice, rats, and other pests.

Burrowing owl
Found on plains of Western Hemisphere
Body length: 23 centimetres

Snowy owl
Found in Arctic
Body length: 51 centimetres

Elf owl
Found in Southwestern United States and Mexico
Body length: 14 centimetres

The sooty owl is a rare bird of the rain forests of coastal north-eastern Australia and New Guinea. In common with other barn owls, it has a distinct facial disc.

It can be up to 76 centimetres long. It has a large head with concentric circles of barred feathers. It usually breeds in the disused nests of other large birds of prey, such as the goshawk, in dense coniferous forest. Great grey owls are very protective of their nest and young. The great grey owl feeds mainly on voles.

The *long-eared owl* is found across the Northern Hemisphere. It prefers coniferous or mixed woods. It can be identified by the lengthwise streaks on its breast and by its ear tufts that lie closer together than those of the eagle owl. Its call is a drawn out 'oooo' sound repeated three times every few seconds.

The *short-eared owl* is also found across the Northern Hemisphere. It is a bird of open country, marshes, meadows, and moorland. It often hunts during the day, gliding low over the ground like a harrier. See **Harrier**. It can be identified by its large, slow flapping wings. Its call is an often repeated 'toot toot toot'. The short-eared owl nests on the ground.

The *snowy owl* lives in Arctic regions. The female is much larger than the male, and is up to 65 centimetres long. The male is almost pure white, the female is more heavily barred with brown. The snowy owl feeds mainly on *lemmings* (small rodents) but will take other mammals and birds. When lemmings are plentiful, they may lay up to 14 eggs. When there are few lemmings, snowy owls may not breed at all. The snowy owl lays its eggs in a hollow in the ground, or on a bare rock ledge. It has a harsh croaky call, almost like a raven.

Scientific classification. Most owls belong to the family Strigidae. They include the burrowing owl *Speotyto cunicularia*, eagle owl *Bubo bubo*, great horned owl *B. virginianus*, great grey owl *Strix nebulosa*, long-eared owl *Asio otus*, and short-eared owl *A. flammeus*. Barn owls are in the family Tytonidae.

The great horned owl is large and powerfully built. It lives in wild country throughout North America.

The great grey owl lives in northern coniferous forests. It fiercely defends its chicks against intruders.

Ownership. See Title.

Ox. Oxen include domestic cattle, water buffalo, bison, musk oxen, brahman, yak, banteng, and other members of the bovine family. Most oxen first lived in Asia and Europe. The musk ox and bison are natives of North America. South America, Australia, and Madagascar have no native oxen.

Oxen have heavy bodies, long tails, and divided hoofs, and they chew their cud. Their smooth horns stand out from the side of the head, and are curved.

Domestic oxen give meat, milk, and leather. They are powerful work animals and serve as beasts of burden in some parts of the world.

Scientific classification. The different kinds of oxen belong to the bovid family, Bovidae. Domestic cattle are *Bos taurus*.

Related articles in ***World Book*** include:

Buffalo
Cattle
Gaur
Kouprey
Musk ox
Takin
Water buffalo
Yak

Oxalic acid is a strong organic acid found in many vegetables and other plants. It occurs abundantly as its potassium salt in the sap of dock and other plants in the oxalis and rumex plant groups. It is found in spinach, rhubarb, tomatoes, grapes, and sweet potatoes. Oxalic acid is also produced in the body. It has been known since early times.

Industry uses oxalic acid in processing textiles, bleaching straw hats, and removing paint and varnish. It is widely used in chemistry as an analytical reagent. Oxalic acid forms substances called *complexes* with various metals, especially iron. For this reason, it is also used as a rust and scale remover.

The acid is prepared commercially by heating sodium formate with sodium hydroxide or by bubbling carbon monoxide gas into a concentrated sodium hydroxide solution.

Oxalic acid occurs as clear, colourless crystals, soluble in water. It is highly poisonous if swallowed. Its chemical formula is $(COOH)_2 \cdot 2H_2O$, and it melts at 101.5° C. This formula is the dihydrate form, as shown by the two water molecules. When heated to 100° C, the crystals lose the water and have the formula $(COOH)_2$ (see **Hydrate**).

See also **Acid; Oxalis.**

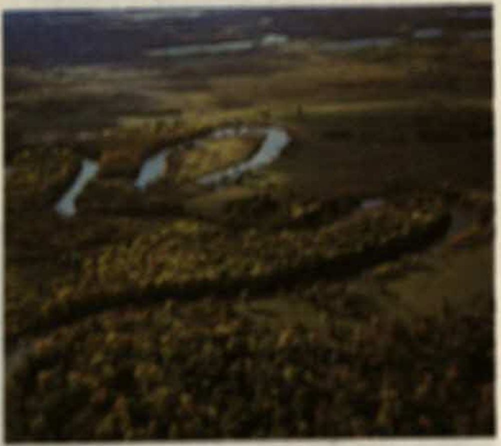
Oxalis is the name of a large group of plants that grow chiefly in South Africa and South America. There are about 850 species of oxalis. Many species grow as weeds. However, some species are cultivated as ornamental plants.

Most kinds of oxalis grow from bulbs, from rootlike *rhizomes*, or from thickened underground stems called *tubers*. They have showy flowers that may be white or a variety of pastel colours. The leaves are shaped somewhat like clover leaves. Both the leaves and flowers close up at night. The leaves taste sour because they contain *oxalic acid*. The acid is so named because it comes from the oxalis plant. The leaves of some kinds of oxalis can be used in salads. One species of oxalis is cultivated in South America for its edible tubers. Wood sorrel is a common plant of the Northern Hemisphere. It has white, purple-veined flowers.

Scientific classification. Oxalis belong to the wood-sorrel family, Oxalidaceae, genus *Oxalis*.

An oxalis has clover-shaped leaves that form neat tufts. *Wood sorrel, above,* is found in the northern temperate region.

Oxbow lake is a crescent-shaped lake that forms when a river channel is cut off from the main stream. Such a lake forms when a river changes its course to a more direct path to the sea. The river leaves deposits of earth at either end of the curve, and these deposits eventually separate it from the main stream. Oxbow lakes are often rather shallow. They may become filled with sediments from river floods and decayed vegetation, and so disappear.



An oxbow lake, *centre,* was once a part of the river in the foreground. Deposits of earth have cut it off from the main stream.

Oxen. See Ox.

Oxenstierna, Axel Gustafsson (1583-1654), a Swedish statesman, was friend and adviser to King Gustavus Adolphus. Oxenstierna's brilliance as a statesman helped the king achieve great military victories. As chancellor, Oxenstierna directed Sweden's political affairs from 1612 until his death. This period marked Sweden's greatest influence in Europe.

Oxenstierna carried out important diplomatic missions for Gustavus Adolphus during the Thirty Years'

War (1618-1648), a struggle between Roman Catholics and Protestants. After Gustavus died in battle in 1632, Oxenstierna directed Sweden's foreign affairs and provided vital leadership throughout the war. From 1636 to 1644, he headed the *regency* (temporary ruling group) that ruled Sweden during Queen Christina's childhood. Oxenstierna was born in Fåno, Sweden.

Oxford (pop. 109,000) is a local government district in Oxfordshire, England. It takes its name from the city of Oxford, which is the administrative centre. The city is the seat of Oxford University, one of Europe's oldest educational institutions. The city of Oxford lies on the River Cherwell and on the River Thames, known locally as the Isis. It is about 80 kilometres northwest of London. Motorcar factories and pressed-steel works are on the outskirts of the city. Famous Oxford institutions include the Ashmolean Museum, the Bodleian Library, and the Botanic Gardens. Buildings of interest in the city of Oxford are the Radcliff Camera and the Sheldonian Theatre, a place used for various official university functions.

See also **Oxfordshire.**

Oxford Movement is the name given to a revival in the Church of England, the official state church in England, which began in 1833 at Oxford. A powerful sermon was preached by John Keble (1792-1866), who tried to show the people the evils that were threatening the church because of their indifference and ignorance. Two leaders joined Keble in the Oxford Movement. One was the brilliant John Henry Newman, and the other was the learned Edward B. Pusey (1800-1882). They preached and wrote for a number of years, seeking to impress on the people that the church was "more than a merely human institution; that it had privileges, sacraments, a ministry ordained by Christ; that it was a matter of the highest obligation to remain united to the Church."

The leaders of the Oxford Movement wrote a series of essays called "Tracts for the Times." These essays were widely read and the movement grew. But in 1841 Newman wrote a tract which was so decidedly Catholic that the Anglican bishops condemned it. In 1845, Newman joined the Roman Catholic Church, and was eventually made a cardinal.

John Keble and Edward B. Pusey continued the work of the Oxford Movement, and new leaders took it up. A notable book, called *Lux Mundi* (*Light of the World*), edited by Charles Gore, afterwards Bishop of Oxford, was published in 1889. It created a great stir throughout the Anglican Communion.

The Oxford Movement had great influence upon the Anglican world. It revived faith in the church as the divine society, not to be controlled by the state. It made the pastor's office more important. The movement increased the importance of tradition and the sacraments. It extended the church's work among the poor in larger cities. And in general it awakened church and laity to a broader view of their power and duty.

See also **Church of England; Newman, John Henry Cardinal; Wilberforce, Samuel.**

Oxford University is the oldest university in Great Britain and one of the world's most famous institutions of higher learning. Oxford University started to develop during the 1100's. It is in Oxford, England, about 80 kilometres northwest of London.

The university has more than 13,000 students. It consists of 35 colleges, plus 5 *private halls* established by various religious groups. Of the colleges, St. Hilda's is for women only, and the rest are for both men and women. These include All Souls, Christ Church, Jesus, Lady Margaret Hall, Magdalen, Nuffield, St. John's, Somerville, and Trinity.

At Oxford, each college is a corporate body distinct from the university and is governed by its own head and *fellows.* Most fellows are college instructors called *tutors,* and the rest are university professors, readers, and lecturers. Each college manages its own buildings and property, elects its own fellows, and selects and admits its own undergraduate students. The university provides some libraries, laboratories, and other facilities, but the

Oxford University is made up of many individual colleges. One of the best known is Christ Church College, *left.* The Memorial Garden in the foreground was laid out in 1926. The English architect Sir Christopher Wren designed the famous Tom Tower on the left about 1680. In the background is Christ Church Cathedral.

colleges take primary responsibility for the teaching and well-being of their students.

Educational programme. Each student at Oxford is assigned to a tutor, who supervises the student's course of study, primarily through *tutorials.* Tutorials are weekly meetings of one or two students with their tutor. Students may see other tutors for specialized instruction. They may also attend lectures given by university teachers. Students choose which lectures to attend on the basis of their own special interests and on the advice of their tutor.

The university, not the individual colleges, grants degrees. The first degree in the arts or sciences is the Bachelor of Arts with honours. Oxford also grants higher degrees, diplomas, and certificates in a wide variety of subjects.

The Rhodes scholarship programme enables students from the Commonwealth and the United States to study at Oxford for a minimum of two years (see **Rhodes scholarship**).

History. During the 1100's, a university gradually developed from a number of schools in the city of Oxford. Its development was aided by a break in relations between England and France in 1167. Hostility between the two nations prevented English students from attending the University of Paris, and many of them went to Oxford instead. The university received its first official recognition in 1214.

The three oldest Oxford colleges—University, Balliol, and Merton—date from the 1200's. Twelve more colleges were founded between 1300 and 1555. The first colleges for women were established during the late 1800's. The university did not grant degrees to women until 1920.

See also **Architecture** (Gothic revival; picture); **Bodleian Library; Europe** (picture).

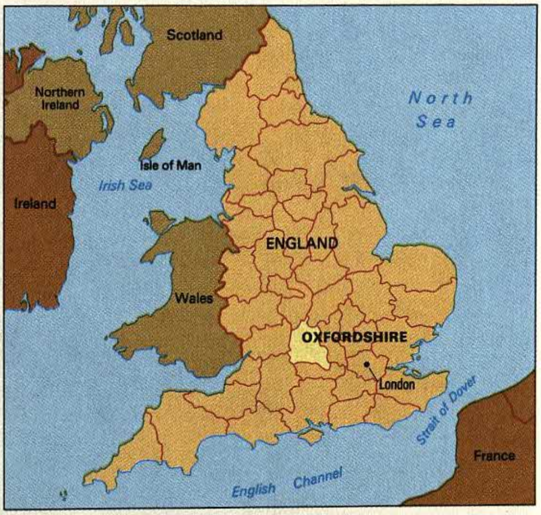
Oxfordshire is an agricultural county with unspoilt scenery, beautiful villages, and historic houses that attract many tourists. It is famous because Oxford, the administrative centre, has one of the world's oldest and greatest universities. Many children have heard of Banbury, the county's second largest town, because of the nursery rhyme that begins: "Ride a cock horse to Banbury Cross. . . ."

Oxfordshire was increased in size in 1974. A large area that had been in Berkshire was added to the county. This area included the towns of Abingdon, Wallingford, and Wantage. It also included the Vale of White Horse (see **White Horses**).

People and government

Local customs. At Oxford, May Morning (May 1) is celebrated by choristers singing at the top of Magdalen College tower. Afterwards, carillonneurs ring the bells.

Recreation. Oxford University's cricket team plays against first-class county teams. Oxford United football team has for a long time played in the Football League. Fox-hunting is popular. In the summer, many people go boating, fishing, or swimming on the River Thames. The International Rowing Regatta at Henley takes place in June. Oxford is a centre for many cultural activities. For example, Oxford Playhouse has a repertory theatre (see **Theatre**).



The county of Oxfordshire lies in southern central England. The River Thames flows eastward through the county.

Local government. The county has five local government districts: *Cherwell, Oxford, Vale of White Horse, South Oxfordshire,* and *West Oxfordshire.*

The crown court sits at Oxford. The Thames Valley Police has its headquarters at Kidlington.

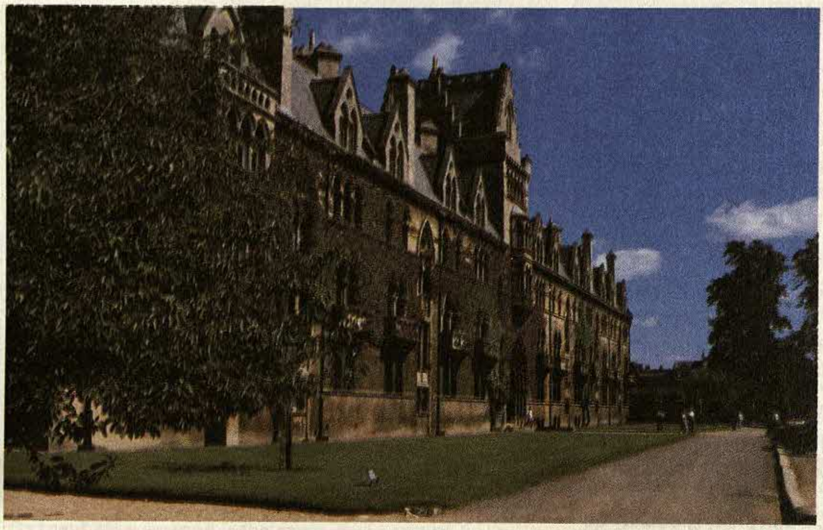
Economy

Manufacturing. The largest industry is motorcar assembly at Cowley, a suburb of Oxford. The business was founded by Lord Nuffield. Also in Oxford are some of Britain's largest printing and publishing firms. Other Oxford companies make agricultural machinery, electrical equipment, and furniture. Banbury has factories that produce agricultural implements, aluminium goods, car accessories, food products, such as instant coffee, and furniture. Abingdon's products include beer, concrete, and scientific instruments. Witney is a centre of traditional Oxfordshire industries, such as making blankets and gloves. Workers at Charlbury and Woodstock also make gloves. Other Witney products are beer, engineering, printing, and scientific instruments.

Agriculture. Oxfordshire is a rich agricultural county. Farmers use a large proportion of the land for growing such crops as barley, oats, and wheat. They also grow some noncereal crops, such as kale, mangolds, potatoes, sugar beet, and turnips. Both beef and dairy cattle thrive on Oxfordshire pastures. Some of the best dairy farms are in the Vale of Aylesbury, in the east of the county. Oxfordshire has as many sheep as it has cattle.

Facts in brief about Oxfordshire

Administrative centre: Oxford.
Largest towns: Oxford, Banbury, Abingdon.
Area: 2,610 km².
Population: *1991 census*—553,800.
Chief products: *Agriculture*—barley, beef and dairy cattle, fruit, kale, oats, pigs, potatoes, poultry, sheep, sugar beet, turnips, vegetables, wheat. *Manufacturing*—agricultural machinery, aluminium goods, beer, blankets, concrete, electrical equipment, food products, furniture, gloves, motorcars, paper, printing and publishing, scientific instruments. *Mining and quarrying*—chalk, iron ore, limestone, sand and gravel.



Oxford's beautiful buildings in varied architectural styles attract many tourists. The city also has large parks and pleasant river walks.

Smallholders grow flowers, fruit, and vegetables in the regions round some of the towns.

Tourism. Oxford is one of England's leading tourist destinations. Oxfordshire's other attractions include its small towns and villages. Boating is a popular pastime.

Transportation and communication. Oxford is well served by a network of main roads. They include the A40 from London to South Wales and the A34 from Southampton to the Midlands. The M40 motorway, which runs through Oxfordshire, connects London with Birmingham and the north of England. Oxford has rail links to London, to Wales and the west of England, and to the Midlands and north of England. The main airport is at Kidlington. A canal runs from Oxford to Birmingham. Oxfordshire has its own BBC radio station and a commercial radio service, a local evening newspaper, and at least 30 weekly newspapers.

Land

Location and size. Oxfordshire lies in the centre of southern England. It is bounded by Warwickshire and Northamptonshire to the north, Buckinghamshire to the east, Berkshire to the south, and Gloucestershire to the west. It extends 68 kilometres from north to south and 53 kilometres from east to west.

Land regions. There are three main land regions. Uplands in the northwest are an extension of the Cotswold Hills. These uplands, which are composed of limestone, average about 150 metres above sea level. They rise to over 225 metres in the Chipping Norton area.

Uplands in the southeast of the county are an extension of the Chiltern Hills. Uplands in the south are part of the Berkshire Downs. These uplands, which are composed of chalk, reach their highest point, more than 240 metres above sea level, near Watlington.

Between the two uplands lie the *Vale of Oxford* and the *Vale of White Horse.* The Vale of Oxford is low lying, with undulating hills, mainly between 60 and 90 metres above sea level. The Vale of White Horse is a flat expanse of clay, with many streams.

Rivers. The Thames is the main river of Oxfordshire. It rises in the Cotswold Hills, in Gloucestershire, and forms the boundary between Oxfordshire and Berkshire for about 30 kilometres. The Thames flows out of the Vale of Oxford through the Goring Gap, which lies between the Chiltern Hills and the Berkshire Downs. The four main tributaries of the Thames are the Cherwell, the Evenlode, the Thame, and the Windrush.

Climate. Average July temperatures in the lowlands are about 17 °C. Average January temperatures in the lowlands are about 3 °C. Upland temperatures run about 4 °C cooler. The average annual rainfall is 635 millimetres in the lowlands and 760 millimetres in the uplands.

Places to visit

Following are brief descriptions of some of the interesting places to visit in Oxfordshire:

Abingdon has ancient buildings. Remains of the abbey, founded in the 670's, include a gateway built in the 1400's.

Blenheim Palace, which stands in a beautiful park near Woodstock, is the most impressive house in Oxfordshire. Sir John Vanbrugh designed the palace in the early 1700's.

Caversfield, near Bicester, has a church dating from Saxon times. The church is famous for its bell, founded in the 1100's or 1200's, and believed to be one of England's oldest.

Oxford is one of the most beautiful cities in Europe. Its main attraction is the colleges, built in a great variety of architectural styles. Oxford also has a Norman castle and fine churches. Its museums include one devoted to the history of science.

Radcot Bridge, near Bampton, is claimed to be the oldest bridge crossing the Thames. It was completed before 1312.

Uffington has a church which is a perfect example of the Early English style of the 1200's. Uffington Castle is an Iron Age earthwork. The White Horse is a huge carving in the downs (see **White Horses**).

History

Prehistoric people built the ancient stone circle at Little Rollright, and similar circles at Enstone, Steeple Barton, and Stanton Harcourt. The Icknield Way, part of which runs along the Oxfordshire Chilterns to the River Thames at Goring, is one of the oldest roads in the British Isles. The Romans built many roads in the area (see **Roman Roads**). Akeman Street, which linked St. Albans and Cirencester, passed through Bicester. The Romans built settlements at Alchester, near Bicester, and at Dorchester.

In the late 700's, the Saxon kingdoms of Mercia and Wessex fought over the area. The Thames divided the two kingdoms. The Saxon king Ethelred II built royal palaces at Headington, Islip, and Woodstock. His son, Edward the Confessor, was born at Islip. The Danes invaded the area in the 800's, and some settled there.

Oxford University dates back to the 1100's. In Oxford, a granite cross marks the spot where the martyrs Archbishop Cranmer, Bishop Latimer, and Bishop Ridley were burned to death in the 1550's.

During the Civil War, Charles I set up his court at Oxford. The Royalist and Parliamentary forces fought many battles in the county.

Warren Hastings, the first governor general of India, was born at the village of Churchill in 1732. Writers born in the county include novelist Maria Edgeworth, who was born at Black Bourton in 1767. Historian J. R. Green was born at Oxford in 1837. William Morris, the writer and social reformer of the 1800's, lived at Kelmscott. Recent novelists who lived in Oxfordshire include Joyce Cary, Graham Greene, and Iris Murdoch. The statesman Winston Churchill was born at Blenheim Palace.

Related articles in ***World Book*** include:

Banbury
Cotswold Hills
Cranmer, Thomas
Edgeworth, Maria
Green, J. R.
Greene, Graham
Henley-on-Thames
Latimer, Hugh
Morris, William
Murdoch, Dame Iris
Oxford
Oxford University
Ridley, Nicholas
Thames, River

Oxidation is a chemical reaction in which a substance loses electrons. The term originally referred to any chemical process in which a substance combines with oxygen. This definition of oxidation was formulated by chemists before they discovered that reactions involving electron loss could occur without oxygen.

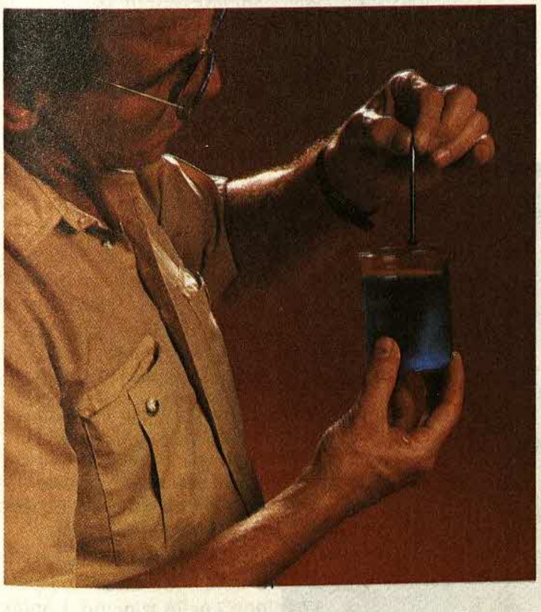
The electrons released during oxidation must be captured by another substance. Thus, oxidation is always accompanied by a reaction called *reduction,* in which a substance gains electrons. The combined transfer of electrons by reduction and oxidation is often called a *redox process.* See **Reduction.**

Oxidation can be demonstrated by heating iron and sulphur together. In this case, each neutral iron atom (Fe) loses two electrons and becomes an iron ion (Fe^{2+}). The chemical equation for the oxidation of iron can be written:

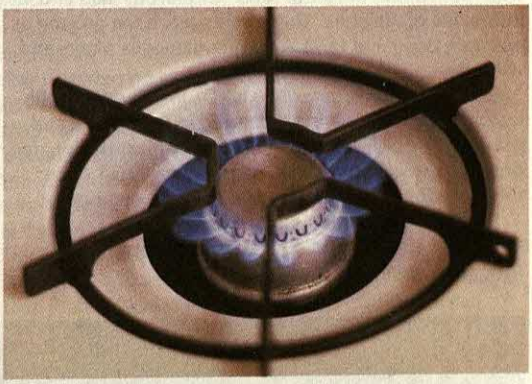
$$Fe \rightarrow Fe^{2+} + 2e^{-}.$$

The electrons released during oxidation are immediately picked up by sulphur atoms, resulting in the formation of sulphide ions (S^{2-}). These sulphide ions combine with the iron ions to form the compound iron sulphide (FeS).

The rusting of iron is a common example of the original meaning of oxidation. Iron combines with oxygen in the presence of moisture to form rust. Another example is the formation of such air pollutants as nitrogen oxides and sulphur oxides. Nitrogen oxides are produced when oxygen combines with nitrogen in hot car engines. Sul-



Electrochemical oxidation occurs when a substance loses electrons. When an iron nail is dipped into a concentrated solution of copper sulphate, *above,* iron atoms in the nail are oxidized. Each iron atom loses two electrons and becomes an iron ion in the solution. Copper ions in the solution capture the released electrons and become copper atoms that coat the nail.



Oxidation with oxygen occurs when oxygen combines with another substance. In a gas flame, *above,* oxygen combines rapidly with the carbon and hydrogen in methane, producing carbon dioxide gas and water vapour. When metal rusts, *below,* iron combines slowly with oxygen and water, forming rust.

phur oxides form when oxygen reacts with sulphur in coal-burning furnaces.

Oxidation also occurs inside the human body when food molecules combine with inhaled oxygen to slowly produce carbon dioxide, water, and energy. The combustion of natural gas and other fossil fuels is a form of rapid oxidation.

Related articles in *World Book* include:

Combustion
Corrosion
Fire
Food (Producing energy)
Oxide
Rust
Spontaneous combustion

Oxide is a chemical compound of oxygen with some other element. Oxides are commonly formed when the elements are oxidized. For example, burning the carbon present in coal or wood gives carbon dioxide (CO_2) and carbon monoxide (CO). Burning is rapid oxidation. Carbon dioxide is also formed by slow oxidation processes in animal cells, and is exhaled from the lungs. The rusting of iron is slow oxidation. Rust contains ferric oxide (Fe_2O_3).

Metallic oxides combine with water to form basic hydroxides, while nonmetallic oxides with water form oxygen acids. The oxides of sulphur and nitrogen are important because they can be used to form acids. However, sulphur dioxide and nitrogen oxides pollute the air when given off by motor vehicles, by factories, and by power plants that burn coal or oil. They also mix with moisture in the air to form sulphurous acid and various acids of nitrogen. These acids reach the ground as *acid rain* (see **Acid rain**). Acid rain damages plants and wildlife.

Calcium oxide is *quicklime* (CaO). When mixed with water it forms the *slaked lime* used in whitewash and plaster. Sand, which is so important in glassmaking, is one form of *silicon dioxide,* called silica (SiO_2). Other forms of silicon dioxide are quartz, onyx, and opal.

See also **Nitrous oxide; Oxidation.**

Oxidizer. See **Rocket** (Rocket propellant; Liquid-propellant rockets).

Oxley, John (1785?-1828), was a surveyor general of New South Wales, Australia. His explorations opened up large areas of land for settlement.

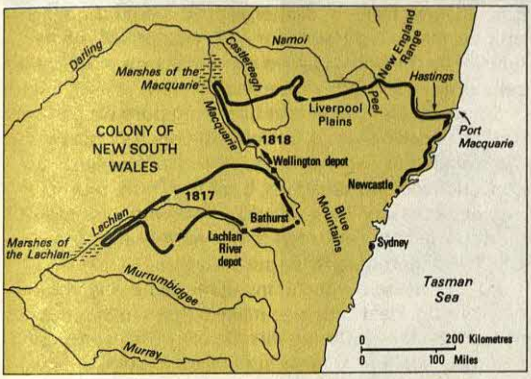
John Joseph William Molesworth Oxley was born in Kirkham Abbey, Yorkshire, England. He joined the navy in 1799 as a midshipman and spent some years sailing Australian waters. After trying several times to obtain an official appointment in New South Wales, Oxley finally succeeded. He became surveyor general of the colony under Governor Lachlan Macquarie in 1812.

John Oxley

After the crossing of the Blue Mountains in 1813, and the establishment of Bathurst, the interior of the colony remained to be explored. Oxley's assistant, G. W. Evans, discovered the Lachlan River, and in April 1817, Oxley set out from Bathurst to explore it. He took along a strong team, including Evans and the botanist Allan Cunningham.

Some of the party rode horses, while others travelled down the Lachlan in boats until extensive marshes blocked their progress. The explorers left the boats and trekked southwest, only to encounter harsh conditions in dry country. Some of the horses died, and the men were reduced to eating dingo, emu, and snake. By early June, near what is now Cocoparra National Park, near Yenda, Oxley wrote that it seemed unlikely that "these desolate plains" would "ever again be visited by civilized man." But Cunningham planted seeds of fruit trees throughout the journey. The explorers turned northwest, met the Lachlan again near the present town of Hillston, and then continued downstream. They were once again blocked by broad marshes in the area of Booligal. Their "disappointment and desolation" forced

The Liverpool Plains were discovered by John Oxley in 1818. He noted, "We seemed to be once more in a land of plenty and horses as well as men had cause to rejoice." Gunnedah is now the central town of this fertile area.



John Oxley explored along the Lachlan River in 1817. In 1818, he led an expedition along the Macquarie River. He named the Liverpool Plains and Port Macquarie.

Oxley "to the conclusion that the interior of this vast country is a marsh and uninhabitable." The explorers turned back. Unknown to Oxley, he was within a few days march of the Murrumbidgee River, which would have led him to enormous tracts of good land.

He returned by a northeasterly route, and came upon the Macquarie River near where Wellington now stands. It was a much bigger stream than the Lachlan, and the surveyor general determined to know more about it.

Exploring the Macquarie. In 1818, Oxley set off from Bathurst with 15 men to follow the Macquarie River. Boats were again used, but were later abandoned when impassable marshes were met. Oxley's theory of an inland sea became more firm. The direction of the river flow seemed "to bear out the conclusion that these waters have but one common reservoir." Turning east, the explorers moved through flooded country, often wading waist deep in water, before crossing the Castlereagh River. On August 26, they climbed a hill and saw a fertile plain, which Oxley named the *Liverpool Plains* in honour of Lord Liverpool, the British prime minister. Continuing east, near the present site of Tamworth, Oxley discovered and named the Peel River.

Crossing the Great Dividing Range proved difficult. Oxley and his companions travelled mountainous, heavily wooded country to the Hastings River, which he named after Warren Hastings, the governor-general of India. As the group followed the Hastings down to its mouth, the men could hear the Pacific Ocean long before they sighted it. They discovered the mouth of the river, and Oxley called the site *Port Macquarie* as a tribute to Governor Macquarie. On the way south to Newcastle, the party had its only serious encounter with Aborigines. One man was speared, and Oxley narrowly avoided the same fate.

Oxley's achievements. Oxley's expedition opened up extensive tracts of new country, including the fertile Liverpool Plains. Soon after Oxley's expedition, another explorer, botanist Allan Cunningham, discovered a direct route to the area.

Today, there are many memorials to Oxley along his track. Perhaps the greatest is the Oxley Highway, which ends at Port Macquarie. After Oxley's second expedition, the British government also changed some of its policies. For example, it encouraged free settlers to make use of the newly discovered pastoral lands. Previously, the government had deterred free emigrants from settling in a penal colony.

Coastal surveys. Oxley's naval training proved useful on coastal surveys. In 1819, he made a sea trip to Jervis Bay, which he mistakenly considered unsuitable for settlement. In that same year, and again in 1820, he surveyed Port Macquarie, recommending that it be used as a place of isolation for hardened convicts. In 1823, he sailed north to Port Curtis, but rejected it as a settlement site.

Turning back to Moreton Bay, Oxley found two shipwrecked convicts living with the Aborigines. The convicts spoke of a large river nearby. This information led to Oxley's discovery of the Brisbane River. Using one of the convicts as a guide, Oxley spent five days exploring the river. He charted its course as far as Goodna, stopping at many points along the bank to examine the soil and trees. Oxley was so impressed by the resources of the river, including its rich soil and its fine hoop pine and other timber, that he recommended the creation of a convict settlement at Moreton Bay.

In September 1824, Oxley headed an expedition to Moreton Bay to select a site for the settlement. After choosing a site at Redcliffe, he turned to the job of mapping the surrounding area. In company with Alan Cunningham and Lieutenant Butler, he proceeded to explore the Brisbane River above the point he had reached in 1823. This expedition took 11 days, and Oxley again made detailed notes on topography and vegetation. After camping on successive nights at Breakfast Creek, near Mount Ommaney and opposite Fairy Bower, a base camp was established about a kilometre upstream from College's Crossing. From there, the party explored the Pine and Crosby mountains and took bearings of peaks in the vicinity. Oxley returned to Redcliffe on October 5. He then visited Peel Island, Dunwich, and Amity Point.

Oxyacetylene. See Acetylene.

Oxygen is a life-supporting gas and a chemical element. Its chemical symbol is O. Nearly all living things need oxygen to stay alive. Oxygen combines with other chemicals in plant and animal cells to produce energy needed for life processes. Oxygen is also needed to make most fuels burn. During the burning process, oxygen combines with the fuel in a chemical reaction. Heat is released during the burning process.

Oxygen is one of the most plentiful chemical elements on the earth. It makes up about a fifth of the volume of air. Nitrogen makes up most of the other four-fifths. Oxygen is also found in the earth's crust and in water. This oxygen is not pure, but is combined with other elements. On the average, 100 kilograms of the earth's crust contains about 49 kilograms of oxygen. Nearly half of the weight of most rocks and minerals is oxygen. Every 100 kilograms of water contains about 89 kilograms of oxygen. Hydrogen makes up the other 11 kilograms.

Chemical properties. Oxygen has an atomic number of 8 and an atomic weight of 15.9994. Ordinary oxygen molecules, such as those that make up about 20 per cent of the atmosphere, have two oxygen atoms bonded together. This ordinary oxygen, O_2, is colourless, odourless, and tasteless. Oxygen molecules that have three oxygen atoms make up a gas called *ozone,* O_3. Oxygen combines with many other elements, forming compounds called *oxides* (see **Oxide**).

Ordinary oxygen changes to a pale blue liquid when cooled to its boiling point, −182.962° C at atmospheric pressure. Oxygen liquefies at a higher temperature when the pressure is increased. At a pressure of 49.7 atmospheres, oxygen liquefies at −118.8° C. These values of temperature and pressure are oxygen's *critical temperature and pressure.* It is impossible to liquefy oxygen at a higher temperature at any pressure. Liquid oxygen is magnetic and can be held between the poles of a strong magnet. It freezes at −218.4° C.

How oxygen supports life. Only a few kinds of living things, including certain germs, can live without *free* (chemically uncombined) oxygen, O_2. Human beings and the other land animals get oxygen from the air. Fish and most other water animals get dissolved oxygen from water. Free oxygen enters a person's blood stream through the lungs. It enters a fish's blood stream through the gills. The blood carries oxygen to the cells of the body. In the cells, oxygen combines with chemicals obtained from food. Energy produced during this process makes it possible for each cell to perform its function in the body. Carbon dioxide is produced in the cells as a waste product (see **Respiration**).

An oxygen tent provides a patient with air that contains more than the normal amount of oxygen. The air is pumped through a hose into the tent, which may cover the entire bed.

Some people believe that breathing pure oxygen will lead to an early death. They think the body's cells will use oxygen too fast, causing a person to die of exhaustion. But in certain situations, breathing pure oxygen may be necessary. For example, pilots who fly at high altitudes, where the air is too thin to supply enough oxygen, breathe from tanks of pure oxygen.

Plant cells use oxygen in much the same way that animal cells do. Plant cells also make oxygen in the process of *photosynthesis.* During this process, the cells use the energy of sunlight to make sugar from carbon dioxide and water. Oxygen is produced as a by-product, and is released into the atmosphere.

Other uses of oxygen. Oxygen has many uses in industry. Some steel is manufactured by the *basic oxygen process.* In this process, a stream of high-pressure oxygen blasts down on melted pig iron and burns out impurities. Welders mix oxygen with fuel in their torches to produce an extremely hot flame with a temperature of about 3300° C.

Liquid oxygen, called *lox,* is used in rockets propelled by liquid fuels. Lox combines with various fuels, including kerosene and liquid hydrogen, to produce the rocket's *thrust* (pushing force). Lox is also mixed with other fuels to make explosives for blasting.

Making oxygen. Most commercial oxygen is distilled from liquid air. During the distillation process, the nitrogen boils before the oxygen does, because nitrogen has a lower boiling point. As the nitrogen boils away, the liquid air is left with a greater concentration of oxygen. Commercial oxygen is stored in steel tanks at a pressure of about 135 atmospheres, more than a hundred times the pressure of the atmosphere.

Small amounts of oxygen can be made by heating potassium chlorate. A little manganese dioxide added to the potassium chlorate speeds up oxygen formation.

History. Oxygen was discovered by two chemists working independently. They were Carl Scheele of Sweden and Joseph Priestley of England. Scheele's laboratory notes show that he prepared oxygen in the early 1770's by heating various compounds, including saltpetre and mercuric oxide. But Scheele's experiments were not published until 1777. Priestley also published his experiments in 1777. He described how he prepared oxygen in 1774 by heating mercuric oxide.

Scheele called oxygen *fire air.* Priestley called it *dephlogisticated air.* In 1777, the French chemist Antoine Lavoisier named the gas *oxygen.* The word means *acid producer.* Lavoisier and others had found that oxygen is a part of several acids. Lavoisier incorrectly reasoned that oxygen is needed to make all acids. He combined the Greek words *oxys* (meaning *sharp* or *acid*) and *gignomai* (meaning *produce*) to form the French word *oxygène.* This word is *oxygen* in English.

Related articles in ***World Book*** include:

Anoxia
Element, Chemical
Iron and steel (The basic oxygen process)
Liquid air
Oxidation
Oxide
Ozone
Welding

A pearl oyster, *above,* has been cut to show two gleaming jewels inside.

Young oysters, *below,* are about as big as a needle point. They swim in the sea.

Oysters fasten their shells to rocks or other hard objects on the ocean bottom. Most species live in shallow coastal waters.

Oyster is a type of shellfish found in oceans and coastal inlets in regions with mild to tropical climates. Oysters have a soft, edible body inside a hard, two-piece shell. The shell is often sharp-edged and very irregular in shape. Oysters live on the sea bottom close to the shore, where the water is usually quiet and not deep.

Oysters are among the most valuable shellfish. Oysters of the Persian Gulf and the Pacific Ocean make the pearls that are used as jewels. People have eaten oysters for thousands of years. About A.D. 43, Roman settlers in England caught oysters along the seacoasts. In winter, they packed the animals in cloth bags and sent them to Rome. Later, the ancient Romans reared oysters on "farms" in the waters off the Italian coasts. Today, many oysters come from undersea farms usually located along the coasts.

Oysters—like clams, mussels scallops, and some other shellfish—are types of *molluscs.* Molluscs make up a major division of the animal kingdom. For a description of other kinds of molluscs, see the *World Book* article on **Mollusc.**

The body of an oyster

Shell. An oyster's shell consists of two parts called *valves.* Oysters are often called *bivalves,* which means *two valves.* The valves are held together at one end by a hinge. One valve is deeper, larger, and thicker than the other valve, and the oyster's body rests on it. The second valve acts as a lid.

The oyster usually keeps the valves of its shell open just a bit. When an enemy comes near, the oyster snaps the valves shut by means of a strong muscle called an *adductor.* This muscle attaches the oyster's body to the inside of the shell. It holds the valves closed until danger has passed. An oyster can keep its shell closed for as long as several weeks.

The *mantle,* a fleshy layer of skin, lines the inside of the shell and surrounds the body organs. It produces liquid substances that harden and form the shell. It also makes the colours and designs that appear in the shell.

Facts in brief

Names: *Male,* none; *female,* none; *young,* spat or seed oyster; *group,* bed.
Hatching period: About 10 hours.
Number of newborn: About 500 million a year for each oyster.
Length of life: About 6 years.
Where found: Mild to tropical seas of the world.
Scientific classification: Oysters used for food make up the oyster family, Ostreidae. The European oyster is *Ostrea edulis.* The most commercially important oyster in Australia is Sydney rock oyster *Crassostrea commercialis.* The oyster of eastern North America is *C. virginia.* The pearl oyster belongs to the pearl oyster family, Pteridae. It is *Pinctada margaritifera.*

The mantle adds material to the shell, so that the shell becomes larger as the oyster grows. Lines on the outside of the shell mark the additions of this material from the mantle. The inside of the shells of oysters used for food is dull white and purple. The inside of pearl oyster shells is covered with a smooth, shiny substance called *mother-of-pearl* or *nacre.* For information about how shells grow, see the *World Book* article on **Shell** (How shells are formed).

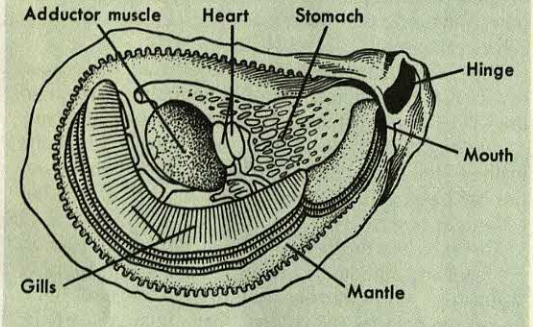
Sometimes a grain of sand or some other object gets into the space between the mantle and the shell and irritates the mantle. The mantle produces layers of shell material to stop the irritation, and in this way a pearl forms. Pearls used as gems come from pearl oysters. These animals live in tropical waters. Oysters used as food may also produce pearls, but these pearls have little value.

Body organs. The oyster's soft body is a greyish mass of tissues that contain the body organs. The animal has no head. It has two pairs of W-shaped gills that look somewhat like a feather. The oyster uses its gills to get oxygen for breathing and also as a filter to capture food. Small hairs called *cilia* on the gills beat and create a current that brings tiny single-celled organisms called *plankton* into the mantle cavity. The plankton get caught on the gill surface and are directed toward the mouth. The oyster's digestive system includes a stomach, two digestive glands, and an intestine.

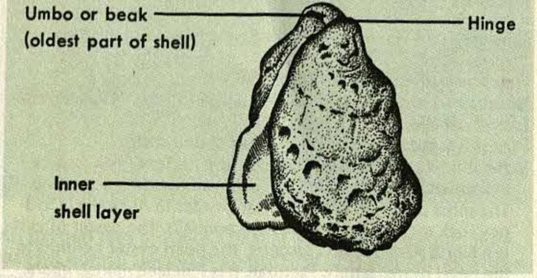
The oyster's heart pumps blood to all parts of the body. The blood carries food and oxygen and removes waste materials from the body.

An oyster has no eyes. However, the animal has two rows of *tentacles* (feelers) on the mantle along the edges of the shell. Changes in light or in chemicals in the water cause the tentacles to *contract* (become smaller). This contraction is followed by a powerful contraction of the adductor muscle, closing the shell against possible danger.

The body of an oyster



The parts of an oyster shell



The life of an oyster

An oyster spends all except the first few weeks of its life in one spot on the sea bottom. It uses the shell material produced by the mantle to fasten itself to a rock or to some other object in quiet waters. The shell substance hardens, and holds the larger valve firmly in place. Most oysters live about 6 years, but some live as long as 20 years.

Young. A female oyster may produce as many as 500 million eggs a year. The yellowish eggs are so tiny that a mass of them looks somewhat like thick cream. The female lays the eggs by spraying them into the surrounding water. A male oyster releases sperm into the water, and the sperm unite with and fertilize the eggs. The *spat* (young oysters) hatch about 10 hours later. Each spat is about as big as the point of a needle. Spat use their cilia to move. When they are about 24 hours old, they form a tiny shell. At this stage, the young oysters are called *veligers.* Oysters cannot be eaten until several months later.

An oyster spends about the first two weeks of its life floating and swimming. During this time, the animal has a muscular "foot" that extends from its body. The oyster uses the foot to test rocks, shells, and other hard objects for a suitable place to settle. The oyster chooses one of these objects and attaches itself to it. Several oysters may attach themselves to the same rock, or they may attach themselves to each other. Oysters frequently form large, crowded *beds* (groups) in rocky inlets along the coasts.

Young oysters grow very rapidly. A month-old oyster is about the size of a pea, and a year-old oyster is approximately 2.5 centimetres in diameter. Oysters grow about 2.5 centimetres a year for three or four years, and then grow even more slowly for the rest of their lives. Some oysters grow as long as 30 centimetres.

Enemies. An oyster has many enemies, and no defence except its shell. Human beings are probably the oyster's greatest enemies. They catch and eat millions of oysters every year. Fish may swallow thousands of newly hatched oysters in one gulp. Crabs and other sea animals eat young oysters after crushing the soft new shells. Starfish pull the shells open with their tube feet and eat the oyster meat. Other enemies of the oyster include oyster-drill snails and some whelks. These animals use their filelike teeth to bore holes in the oyster's shell and suck out the soft parts. A bird called the oystercatcher pries open oyster shells with its strong beak. Diseases caused by viruses that are harmless to human beings may kill millions of oysters in a single year.

The oyster industry

Oyster farming. Oysters are one of the most popular foods that people take from the sea. Fondness for eating oysters—and fear that they might die out—led people to rear the animals on undersea "farms."

An oyster farmer chooses an area of quiet water where the sea floor is firm. Loose, shifting sand or soft

Harvesting oysters with a dredge, oystermen watch the heavy net haul up their catch from the ocean bottom. The oysters are taken into port to be cleaned and packaged for market.

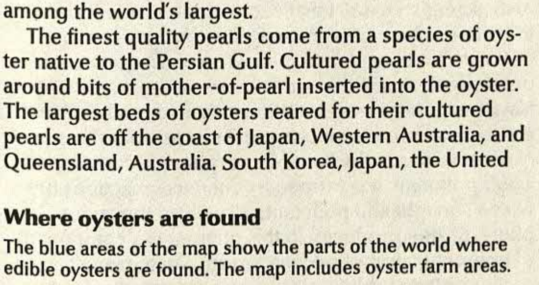
mud might cover and smother the oysters. Each farmer marks a plot with floats and puts old shells or tiles on the sea floor. The shells and tiles provide places for the young oysters to attach themselves. The oyster farmer can buy *seed oysters* to "plant" in the farming area. The oysters are harvested when they are 2 to 4 years old and 5 to 10 centimetres in diameter.

Almost all the oysters reared for market come from oyster farms. One of the largest oyster-farming centres in the world is in the Bay of Arcachon, on France's southwestern coast. The beds in American coastal waters, especially those of Chesapeake Bay, are also among the world's largest.

The finest quality pearls come from a species of oyster native to the Persian Gulf. Cultured pearls are grown around bits of mother-of-pearl inserted into the oyster. The largest beds of oysters reared for their cultured pearls are off the coast of Japan, Western Australia, and Queensland, Australia. South Korea, Japan, the United States, and France are the world's leading oyster-producing countries.

Where oysters are found

The blue areas of the map show the parts of the world where edible oysters are found. The map includes oyster farm areas.



Oyster harvesting takes place during autumn and winter in most regions. Groups of oysters in shallow waters are picked up with tongs that open and close somewhat as scissors do. Oysters in deeper waters are brought up by machines called *dredges.* The dredges are operated by hand or by steam power.

Some oysters are sold while still in their shells. Workers pack the oysters in ice before shipping. Most oysters are sold unshelled. Workers called *shuckers* remove the shells. A shucker places the edge of the shell on a chisel blade, which is fastened to a heavy block of wood. Then the shucker hits the shell with a wooden hammer. The blow drives the tip of the chisel between the valves of the closed shell. The shucker then slips a knife blade into the shell and pulls it open so that the valves lie flat. The adductor muscle, which attaches the body to the shell, is cut, and the soft flesh is removed, washed, and packed for shipment. Oysters are most popularly kept cool on a bed of ice and eaten raw.

See also **Mollusc; Mother-of-pearl; Pearl; Shell; Aquaculture.**

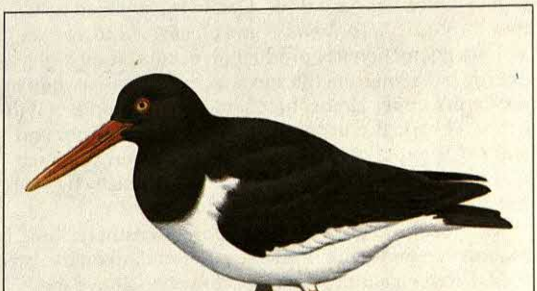
Oyster plant. See **Salsify.**

Oystercatcher is the name of several species of wading birds that live on seacoasts in most parts of the world. The name comes from the oystercatcher's sharp-edged, chisel-shaped bill, which the bird uses to open the shells of such molluscs as mussels and oysters, and to pry limpets from rocks.

The plumage may be black and white or all black depending on the species. The Eurasian oystercatcher is black above and white below. The sooty oystercatcher of Australia is an all black bird.

Oystercatchers have noisy courtship displays that may involve several birds all uttering their shrill calls at the same time. Oystercatchers lay two to four blotched and speckled sand-coloured eggs, that blend in with the pebbles among which they are laid.

Scientific classification. Oystercatchers belong to the family Haematopodidae, genus *Haematopus.* The European oystercatcher is *H. ostralegus,* the Australian oystercatcher is *H. fuliginosus.*



The oystercatcher uses its sharp bill to open molluscs.

Ozalid process is a method of producing copies of documents. The original paper is placed on a chemically treated sheet of Ozalid paper and fed into an Ozalid machine. Ultraviolet light shines through the translucent paper of the original copy and changes the chemicals on the Ozalid paper to a colourless compound. But the ultraviolet light does not shine through the opaque lines or letters on the original copy. The machine then develops the Ozalid paper, and the parts not struck by ultraviolet light appear, making a copy. The Ozalid process has been largely replaced by photostatic processes and other copying methods (see **Photocopying** [Projection photocopying]).

Ozawa, Seiji (1935-), is one of the outstanding orchestra conductors of his time. He established his reputation with a broad range of music, including that of many modern Japanese composers.

Ozawa was born in Hoten, Manchuria. He went to Europe in 1959 and studied with the Austrian conductor Herbert von Karajan in West Berlin. There, Leonard Bernstein, conductor of the New York Philharmonic Orchestra, observed Ozawa and named him one of the orchestra's three assistant conductors for the 1961-1962 season. Bernstein recalled him as sole assistant conductor for the 1964-1965 season. Ozawa was the Toronto Symphony's conductor from 1965 to 1969 and the San Francisco Symphony's music director from 1968 to 1976. In 1973, he also became artistic and music director of the Boston Symphony.

Seiji Ozawa

Ozone is a form of oxygen that is present in the earth's atmosphere in small amounts. Ozone in the upper atmosphere is a major factor in making life on the earth possible. But ozone in the lower atmosphere contributes to air pollution. Ozone is used commercially in water purification processes and as a bleaching agent.

Ordinary oxygen molecules have two oxygen atoms. Ozone molecules have three. Ozone is produced naturally through *photochemical* and *electric discharge* reactions. Photochemical production occurs when high energy radiation from the sun strikes ordinary oxygen in the earth's upper atmosphere and converts some of it to ozone. Electric discharge reactions, including lightning and electric sparks from motors, also convert some oxygen to ozone. Ozone is produced commercially by electric discharges in a machine called an *ozonizer.*

Most ozone is found in the upper atmosphere. The highest concentration is reached, depending on the latitude, between about 15 and 30 kilometres above the earth's surface. This concentration is 10 parts per million by volume—that is, 10 parts ozone per 1 million parts air. The ozone layer in the upper atmosphere shields the earth from 95 to 99 per cent of the sun's ultraviolet rays. Overexposure to these rays is a leading cause of skin cancer.

In the mid 1970's, some scientists expressed concern that chemical compounds called *chlorofluorocarbons* (CFC's) were breaking down the protective ozone layer. At that time, CFC's were widely used as propellants in aerosol spray cans. After CFC's are released, they slowly rise into the atmosphere. When they reach the upper atmosphere, the sun's ultraviolet radiation breaks them apart. Some of the molecular fragments that result react with ozone, thereby reducing the amount of it.

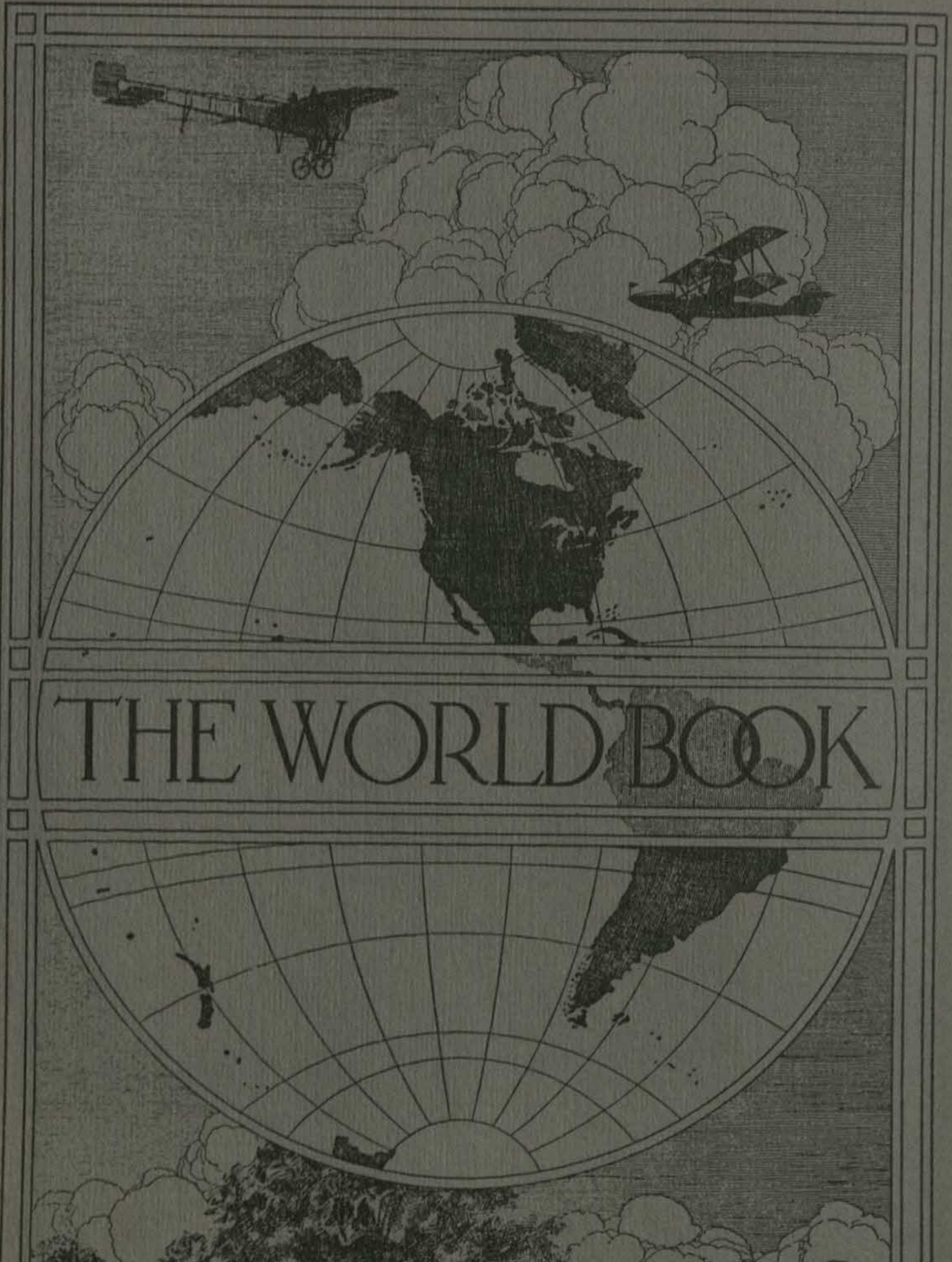
Scientists soon discovered that the decrease of ozone in the upper atmosphere depends on the latitude. The decrease is the strongest in regions over the south pole, where it forms a "hole". Scientists from the British Antarctic Survey published the first report of the existence of an ozone hole above the Halley Bay in 1985. In 1986, NASA, together with such organizations as the World Meteorological Organization and the United Nations Environmental Programs (UNEP), set up the Ozone Trend Panel to study ozone depletion in the atmosphere. Members of this panel collected data from satellites and from instruments on the ground. They published their findings in March 1988, confirming that the ozone levels above the Antarctic were decreasing. They also found that ozone levels were decreasing in Arctic regions, but to a lesser degree than the formation of the ozone hole above the Antarctic. In Europe, Germany and France launched a series of research projects named Chemistry of Ozone in the Polar Stratosphere Project (CHEOPS) to study ozone depletion in the northern regions.

In 1987, 31 nations signed the Montreal Protocol, a treaty to limit the production of CFC's. This treaty took effect on January 1, 1989. In 1990, a reevaluation of the Montreal Protocol established that the world-wide increase in production of CFC's had slowed down. But it was found that some of the compounds introduced to replace CFC's were also harmful to the ozone layer, especially hydrochlorofluorocarbons (HCFC's). A revision of the Montreal Protocol of 1990 calls for the complete elimination of the production of CFC's by the turn of the century.

CFC's will contaminate the atmosphere for many years after the production of CFC's ends. This is because large amounts of CFC's from existing refrigerators and air-conditioning systems are leaking into the atmosphere. Also, scientists expect that ozone depletion will continue to increase over the next few decades because CFC's are long-lived molecules. The consequence of ozone depletion will be an increase in the amount of ultraviolet light that reaches the earth, especially in southern Australia and New Zealand. See **Fluorocarbon.**

Most ozone in the lower atmosphere is considered an air pollutant. It is formed by chemical reactions between sunlight and pollutants already in the atmosphere. Ozone produced in this manner is a component of photochemical smog (see **Smog**). Such ozone can directly damage rubber, plastic, and plant and animal tissue. It may undergo further chemical reactions that produce other damaging chemicals. Exposure to certain concentrations causes headaches, burning eyes, and irritation of the respiratory tract in many individuals.

Ozone has the chemical formula 0_3 and a molecular weight of 47.998. Pure ozone is a pale blue gas. It was first detected by means of its sharp, irritating odour, which is often noticed near electrical switches and machinery. The German chemist Christian Friedrich Schönbein discovered ozone in 1840.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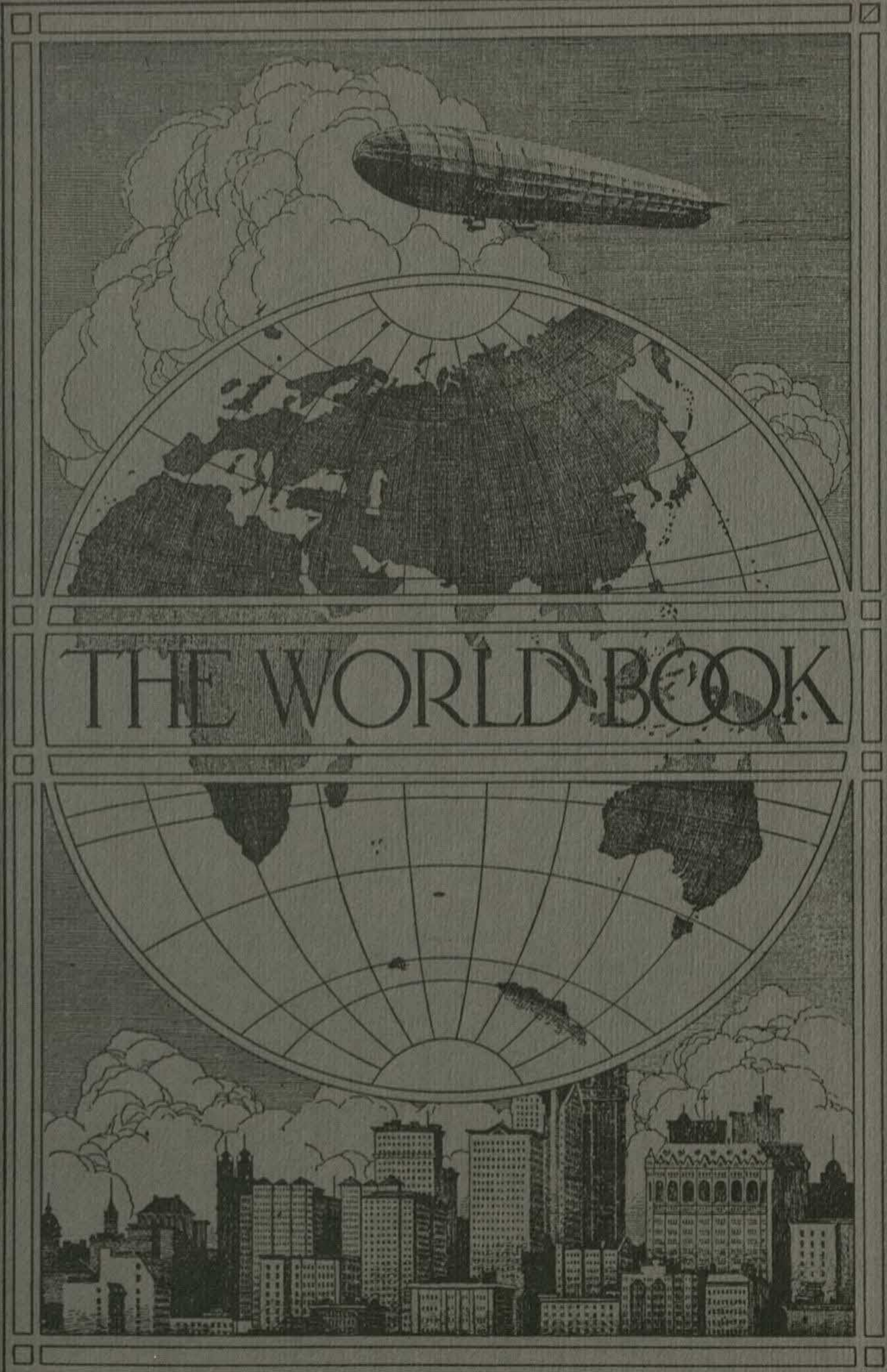

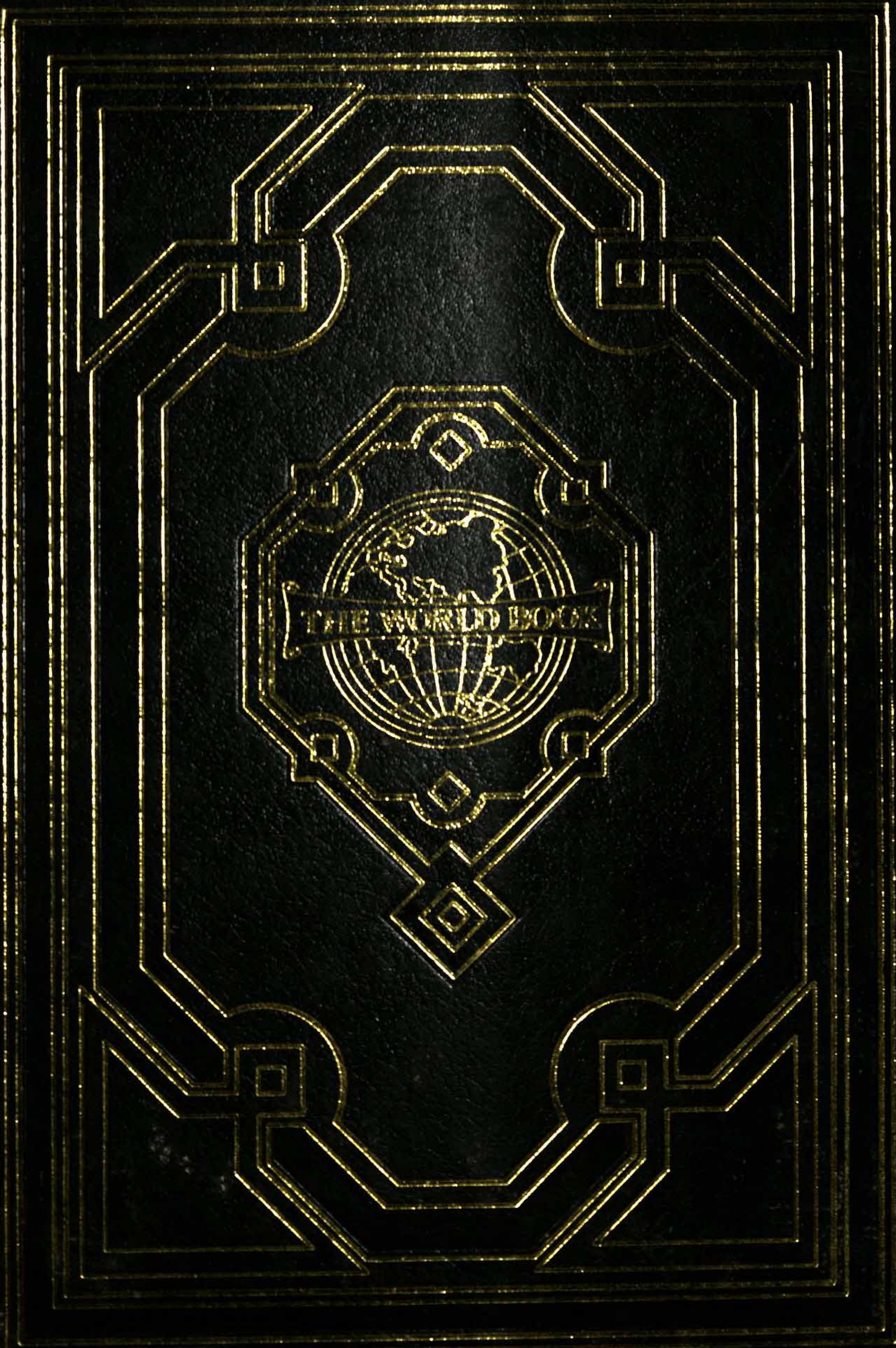
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